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SAULT STE. MARIE REGION CONSERVATION REPORT

[General publications]

1969

ONTARIO

DEPARTMENT OF ENERGY AND RESOURCES MANAGEMENT

CONSERVATION AUTHORITIES BRANCH

SAULT STE. MARIE REGION CONSERVATION REPORT

1959

DEPARTMENT OF ENERGY AND RESOURCES MANAGEMENT

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A. S. L. BARNES
Director, Conservation Authorities Branch

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1969

TORONTO

CONSERVATION AUTHORITIES BRANCH

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INTRODUCTION

During the year 1967, we heard a great deal about Man the Explorer, Man the Producer and Man the Provider, but practically nothing about Man the Conservator. The role of man for the next hundred years must be that of Man the Conservator if he is to survive on this planet.

In Ontario we have had a few conservators in the past but are still far from being able to regard man in the broad sense as a conservator in this Province. At the present time, it would be fair to say that a substantial beginning has been made.

One of the most forward-looking steps was taken by the Government of Ontario when it passed The Conservation Authorities Act in 1946. Where else would one find over 800 people dedicated to the cause of conservation who devote so much of their own time with no remuneration other than a per diem allowance and mileage for attending meetings?

The Conservation Authorities Act was passed with three basic ideas in mind:

1. That the watershed is the best unit area on which to co-ordinate conservation work;

2. That the initiative for the establishment of a Conservation Authority must come from the local people; and

3. That the Government of Ontario will provide technical assistance and substantial grants to conservation authorities.

Since 1946, 38 authorities have been established, 33 in Southern Ontario and five in Northern Ontario. These embrace 561 municipalities and have jurisdiction over an area of 29,061 square miles. In other words, 4,500,000 people or 75 per cent of the total population of the Province live in watersheds covered by authorities. It is anticipated that before long conservation authorities will be established over the whole of southern Ontario.

In order to establish an authority, the councils of two or more municipalities lying wholly or partly within a watershed must petition the Minister of Energy and Resources Management to call a meeting to discuss the question of whether or not such an authority should be established. The Minister then names the time and place of meeting and advises each municipality how many representatives it is entitled to send to the meeting. A quorum for the meeting is two-thirds of all the representatives who may attend. At this meeting the Director of the Conservation Authorities Branch or his representative acts as chairman and the whole question of authorities including establishment, financing, programs and specific problems is discussed in detail. If a resolution is presented by one of the municipalities requesting the Minister to establish an authority, the resolution is voted on and requires a two-thirds majority vote of representatives present to pass. If it passes, then all municipalities in the watershed become members and the authority is established by order-in-council.

The Sault Ste. Marie Region Conservation Authority, which comprises an area of 83 square miles, was established November 21, 1963.

The first meeting of the authority is called by the Minister and the Director of the Branch acts as chairman until the representatives of the municipalities elect their own chairman and vice-chairman from among themselves. Then an executive committee may be elected, advisory boards set up and a tentative program outlined.

One of the first services provided by the Branch to each authority is the preparation of an overall conservation report with recommendations based on field surveys covering water, land, forests, wildlife, recreation and history. This is designed to serve as a guide to the authority in developing its conservation program for the whole watershed.

The responsibility for initiating all projects lies with the conservation authority but the authority may obtain a very considerable amount of assistance from the various departments of government, namely, grants and technical help from the Department of Energy and Resources Management, and advice in specialized fields. A resources manager, who is a member of the staff of the Department, has been seconded to the authority to advise the authority and carry out its field program.

This Report to the (Sault Ste. Marie Region Conservation Authority) embodies the results of recent field surveys and other investigations conducted by the Conservation Authorities Branch.

A. S. L. Barnes,
Director,
Conservation Authorities Branch,
Department of Energy and
Resources Management.

CONTENTS

PART 2 — WATER, Continued

ILLUSTRATIONS

RECOMMENDATIONS

RECOMMENDATIONS

1. That the Authority prepare and register fill and construction regulations under the provisions of Section 26 of The Conservation Authorities Act, 1968; and that priority on the preparation of these regulations be given to the urbanized and urbanizing areas of the Authority.

2. That the Authority, with the co-operation of the local health department, investigate all drainage pipes which have an outlet into adjacent streams in residential areas. This program would determine if pollutants are being discharged into the streams.

3. That the Authority investigate the degree of pollution in the ditches north of the Base Line Road in the vicinity of the slag dumps.

4. That the Authority recommend curtailment of any expansion of the area of the leased municipal dump adjacent to a tributary stream of the Root River in Tarentorous Township, and investigate the possibility of pollutants now entering the stream from this dump.

5. That the Authority consider site locations and the advisability of acquiring parcels of land for future development of recreation areas.

6. That the Authority encourage effective land-use planning in the Rankin Indian Reserve, especially along the rivers.

7. That the Authority acquire and develop the Gros Cap area and other unique physical features.

8. That the Authority co-operate with local municipalities and the planning board and encourage them to designate as "Major Open Space", in Official Plans and Zoning By-Laws, the lands delineated under the Authority's proposed fill and construction regulations.

9. That the Authority urge municipalities to discourage urban development on slopes greater than 22 per cent.

10. That the Authority co-operate with and encourage local municipalities to ensure that the design of development on the steep slopes above and below the Korah Bench will be such that this valuable physical feature is preserved for eventual public open space.

11. That the Authority establish snow courses at strategic points in its northern region, to study the effect of local forest cover on snow conditions and runoff, in consultation with the Conservation Authorities Branch of the Department of Energy and Resources Management.

12. That the Authority proceed with a phased program for providing flood control in critical downstream areas of East Davignon, Central, West Davignon, Bennet and Leigh Bay Creeks.

Recommendations, Continued

13. That the Authority inspect the streams under its jurisdiction at regular intervals and solicit the assistance of the city and township Works Departments in establishing a maintenance program for the removal of debris from stream channels.

14. That the Authority request regular monitoring of the water quality in all its streams by the O.W.R.C. and encourage the provision of adequate sewage services by the city to all areas in the municipality as soon as it is economically feasible.

15. That the Authority encourage the use of design flows given in Table 13 as criteria for future construction of improvements, diversions, bridges or any control on streams in the Authority.

16. That the Authority investigate the possibility of acquiring the Algoma Retriever Club Dam for conservation purposes.

LAND AND FOREST

CHAPTER I

SAULT STE. MARIE REGION CONSERVATION AUTHORITY

1. General

The Sault Ste. Marie Region Conservation Authority is situated in the District of Algoma, on the north shore of the St. Marys River, between Lake Superior and Lake Huron. The Authority was established on November 21, 1963, with four participating municipalities: the city of Sault Ste. Marie and the townships of Prince, Korah and Tarentorous. The subsequent amalgamation of the city and the townships of Korah and Tarentorous reduced the number of participating municipalities to two. At present, the entire city of Sault Ste. Marie and approximately two-thirds of the township of Prince compose the 83 square miles of the Authority. The population and taxable assessment for the city of Sault Ste. Marie in 1967 were 74,791 and $247,209,000 respectively. It is estimated that 90 per cent of the 599 population and $390,000 taxable assessment of the township of Prince is within the official Authority boundary.

The problem that arises in defining a resources management system is that it can be viewed from a number of different perspectives which depend on the interests of those responsible for its management. Traditionally, resources planners have viewed the system as a physical entity consisting of the total water and related land resources. However, an economist might view the system as a design for obtaining the maximum economic benefits from the resources at the least economic cost. Similarly, a politician might consider a resources system as a method whereby the conflicts of various groups interested in the use and management of the resources may be resolved. The Conservation Authority, as a manager of the total natural, renewable resources of the system, is in the unique position of reconciling these interests in order to best serve the public, who will inevitably pay for, and benefit from, a wise management of the water and land resources of the system.

The approach utilized in this report considers all of these perspectives in an attempt to provide a basis for the solution of resource management problems in the Sault Ste. Marie Region Conservation Authority.

2. Physiography

The physiography of the Sault Ste. Marie Conservation Authority can be divided into three broad belts, each of which is the consequence of glacial activity during the latter part of the Wisconsin Ice Age. The most northerly belt displays a moderately rolling terrain of glacio-fluvial deposition; while the two lower belts display moderate to gentle slopes of fluvial and lacustrine deposits, respectively.

a. The deep glacial deposition, combined with isolated exposures of Precambrian rock in the northern belt, has created a varied landscape which has been designated the Prince Landscape. The southern limit of the Prince Landscape is demarcated by a line projected from the south face of the exposed Precambrian rock bluffs in Prince Township and directed in a north-easterly direction along the 1000 foot contour line.

This boundary line coincides, more or less, with the upper bench limits of Lake Algonquin.

The Precambrian rock bluff on the south-western limits of the Prince Landscape dips in the vicinity of Prince Lake Road and is obscured by glacial deposition. This glacial till is rather shallow adjacent to the north side of the rock bluffs, but it is thought that the glacio-fluvial deposits increase in depth as one proceeds in a north-easterly direction toward the extensive Goulais River outwashes.

Soil textures found in the upper strata of various soil formations indicate, to a degree, the type of deposition which prevailed in an area. In the Prince Landscape, stone-free, medium to coarse sands, from 10 to 20 feet in depth, were found overlying glacial deposits of gravel in the Prince Lake and Allard Lake areas. Apparently a pause occurred in the recession of glacial ice in this vicinity. This pause would have allowed a large concentration of water to accumulate and hence the finer particles and sand were able to settle over the earlier morainic till from the Goulais River outwashes. Rolling topography and the presence of numerous gravel pits give indications of an extensive terminal moraine in the south-eastern portion of the Prince Landscape and adjacent to the Algonquin Terrace.

b. The second physiographic belt of the Sault Authority is the Algonquin Terrace. It has its derivation from several benches that were developed during the Lake Algonquin stage. The intermediate benches, some of them now obscure, were created during interglacial lake periods and fashioned a moderately sloping topography*. However, the Korah Bench which forms the lower margin of the terrace, is quite evident in the municipality's landscape.

The southern face of the Precambrian bluffs in Prince Township was subjected to "wave-washing" from the waters of the various inter-glacial lakes of the Lake Algonquin stage and the extensive washing action deposited silt and sandy loam over medium-textured sand at the base of the bluffs. Due to the dipping of the Precambrian rock near Prince Lake Road and the extensive morainic cover within the Authority's area, the extent and perimeter of the Precambrian rock is rather nebulous, and the assumption that the front edge of the Precambrian rock coincides with the upper Lake Algonquin Bench needs further investigation. Extensive gravel pit operations and deep well borings indicate that sand-gravel material is encountered at considerable depths without catching Precambrian rock. Near the intersection of Peoples Road and the 4th Line, a bore hole went through 215 feet of sand-gravel material before striking sandstone, and continued for another 100 feet into the sandstone before the drilling was stopped. Log core data submitted to O.W.R.C. by well-drillers have indicated that sand-gravel material had been encountered to depths of 150 feet in the vicinity of the 5th Line#.

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* Hough, J. L., Geology of the Great Lakes; University of Illinois Press, 1958; p. 235.

\# Personal communication with T. J. Yakutchuk, Supervisor of Surveys & Projects, Division of Water Resources, Ontario Water Resources Commission.

General view of Authority from the Prince Landscape Unit. The beach terraces can be seen in the background.

Topsoil on the lower reaches of the Algonquin Terrace is of a sandy-loam texture, thus indicating a possible lacustrine deposition. Furthermore, wave washing of the higher benches could also have contributed fine sediment to the lower benches of the Algonquin Terrace.

c. The third and lowest of the physiographic belts is the Nipissing Terrace which lies between the Korah Bench and the present Great Lakes water level. The topography is gently sloping and consists of fine-textured silt soils of lacustrine deposition. It is on this lower terrace that the greatest extent of urban development has taken place.

It is evident from these descriptions that each belt has its own characteristic landscape and consequently is subjected to different rates of soil erosion problems and land use.

3. Soils

Generally the soils in the Sault Ste. Marie Conservation Authority's area belong to the great soil groups of Brown Podsolic and Grey-Brown Podsolic soils, with high leaching susceptibilities due to the granular particles of the glacio-fluvial deposits. The glacial activity and the subsequent gradation of varying soil textures of sands, gravels and silts form different soil erosion-prone situations, since each soil texture possesses different cohesive tendencies.

There are eight streams which flow through the Authority, each travelling through various segments of the different soil types, and consequently creating varying degrees of stream-bank erosion. In addition, the accumulation of sediment at the lower elevations of the streams and the encroachment of urban development upon streambanks and valleys is becoming more of a problem. Hence, the remainder of the land-use segment of this report will deal with the various problem areas observed during the field survey of the Authority's area.

4. Trash and Landfill

The most striking observable condition of the areas along the numerous stream beds within the Authority was the indiscriminate dumping of refuse material into, or immediately adjacent to stream beds. Some of the locations of this dumping were on private property while other sites were on public property.

An example of indiscriminate refuse dumping by the local citizenry was observed at the point where the 3rd Line crosses Fort Creek (see Refer. No. 1)*. As evident in Photo #1, this location has accumulated trash material, ranging from discarded clothing to automotive bodies, for some time. Furthermore, it should be pointed out that this refuse dump lies immediately upstream from the Fort Creek Reservoir and Recreation site, and therefore should receive immediate attention. Elsewhere in the Authority, two notable refuse dumps were observed at locations on the Big Carp River (see Refer. Nos. 2 & 3). The refuse dump at point #2 (see Photo #2), is a private dump site for the present landowner, while at point #3 the local citizenry have availed themselves of the

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* Locations mentioned in the text can be located on the Land Conservation Problem Map by the corresponding number for reference purposes.

opportunity to dump trash on private property. Other locations have been indicated on the Land Problem Map (Fig. 1) by the symbol noted in the map legend.

The extent of the Authority's area makes policing difficult. However, locating offenders may be possible from an examination of the composition of some of the material dumped at the various locations. A publicity campaign by the municipality and the Authority could be implemented to discourage the dumping of refuse material in unauthorized locations.

The municipality's present procedure of land filling gravel pits (in Lot 27, Tarentorous Township) with garbage refuse has some merits (see Ref. No. 4). However, any further northerly extension of the leased pit for dumping purposes should receive further investigation since the proximity of garbage fill to a tributary stream may result in pollution.

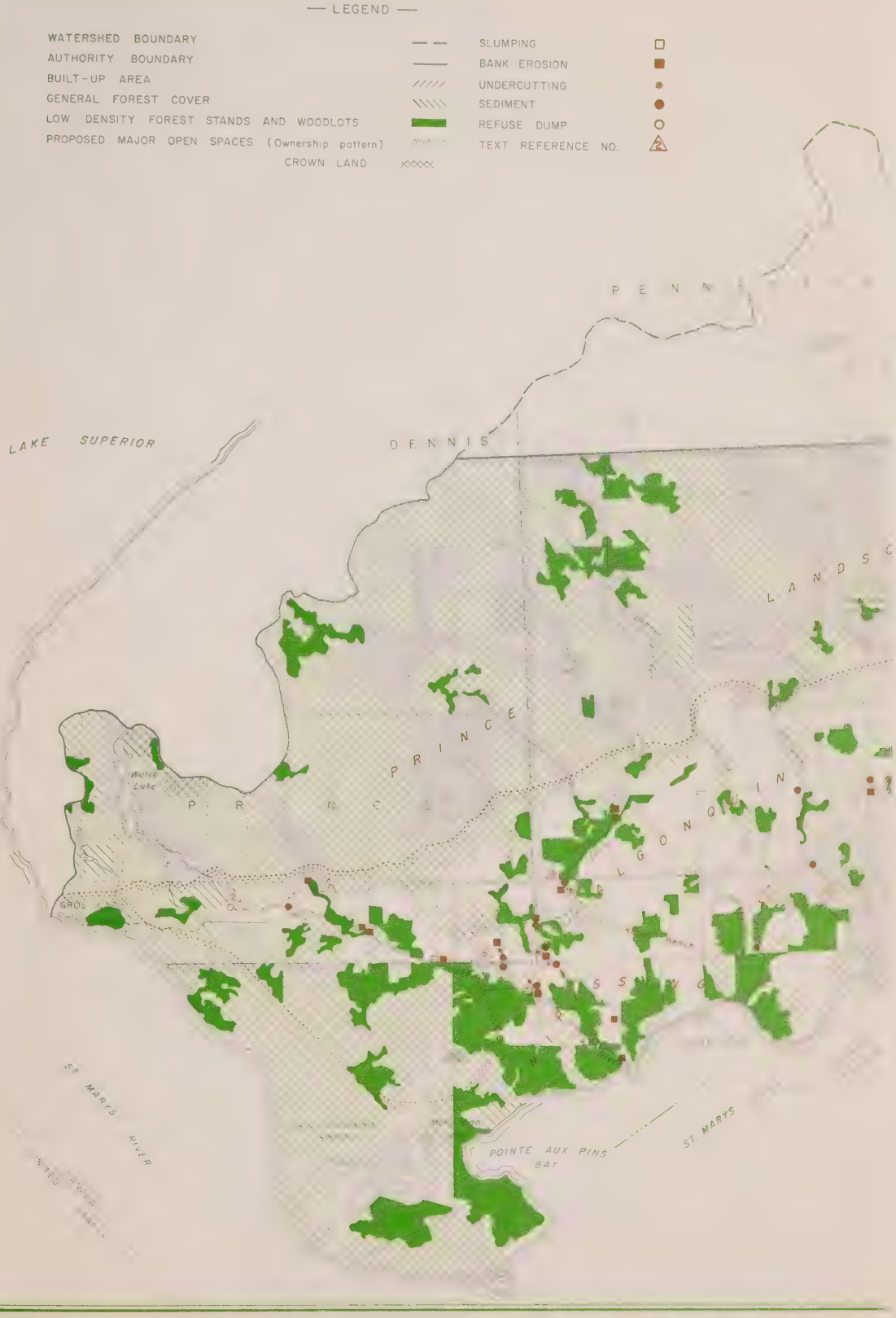
In the north-east corner of the dumping area, the bottom edge of the garbage fill lies within 100 feet of the stream bank and practically at the same elevation as the water level of the stream. Coarse gravel and boulders have been mounded to a height of two feet along the stream bank to serve as a dike. Nevertheless this coarse, unconsolidated material would provide little flood protection to the base of the garbage fill area during a heavy spring runoff. The gradient of the stream in this area is such that any voluminous flow of turbulent water could obliterate the dike, change the stream course, and possibly undermine the garbage fill. The exposed gravel cover on the garbage debris is susceptible to erosion with the consequence that runoff-water laden with garbage pollutants may reach the tributary stream of the Root River system; moreover, the accumulation of polluted water behind the dike would create ponding situations.

The municipality's use of garbage material as fill in land reclamation of extensive, abandoned gravel pits is commendable. However, several procedures should be implemented to complete the program and to attain a satisfactory standard.

5. Land Fill

Expansion of urban development in the Authority has encroached upon the upper benches, especially upon the Korah Bench where deeply incised valleys are numerous. Property owners often employ improper land-fill methods to obtain maximum useable areas of their holdings.

One situation involved a recent subdivision development adjacent to the north-west corner of the Fort Creek Reservoir Site. A deep gully was filled with clay soil to a depth of approximately 50 to 60 feet to ensure that the filled area could be used as a park for future residents. Deeply entrenched in the fill material was a concrete storm sewer pipe that discharged water received from the storm sewers of the development scheme (see Ref. No. 5). The discharged water presumably would continue flowing down through the gully. As revealed by Photo #3, the concrete drainage pipes are undermined, and the fill material is subject to erosion. Moreover, the fill material that is eroding away is reducing the potential play area of the intended park site.


— LEGEND —
WATERSHED BOUNDARY
AUTHORITY BOUNDARY
BUILT-UP AREA
GENERAL FOREST COVER
LOW DENSITY FOREST STANDS AND WOODLOTS
PROPOSED MAJOR OPEN SPACES (Ownership pattern)
CROWN LAND
SLUMPING
BANK EROSION
UNDERCUTTING
SEDIMENT
REFUSE DUMP
TEXT REFERENCE NO.
LAKE SUPERIOR
DENNIS
PRINCE
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ST MARYS RIVER
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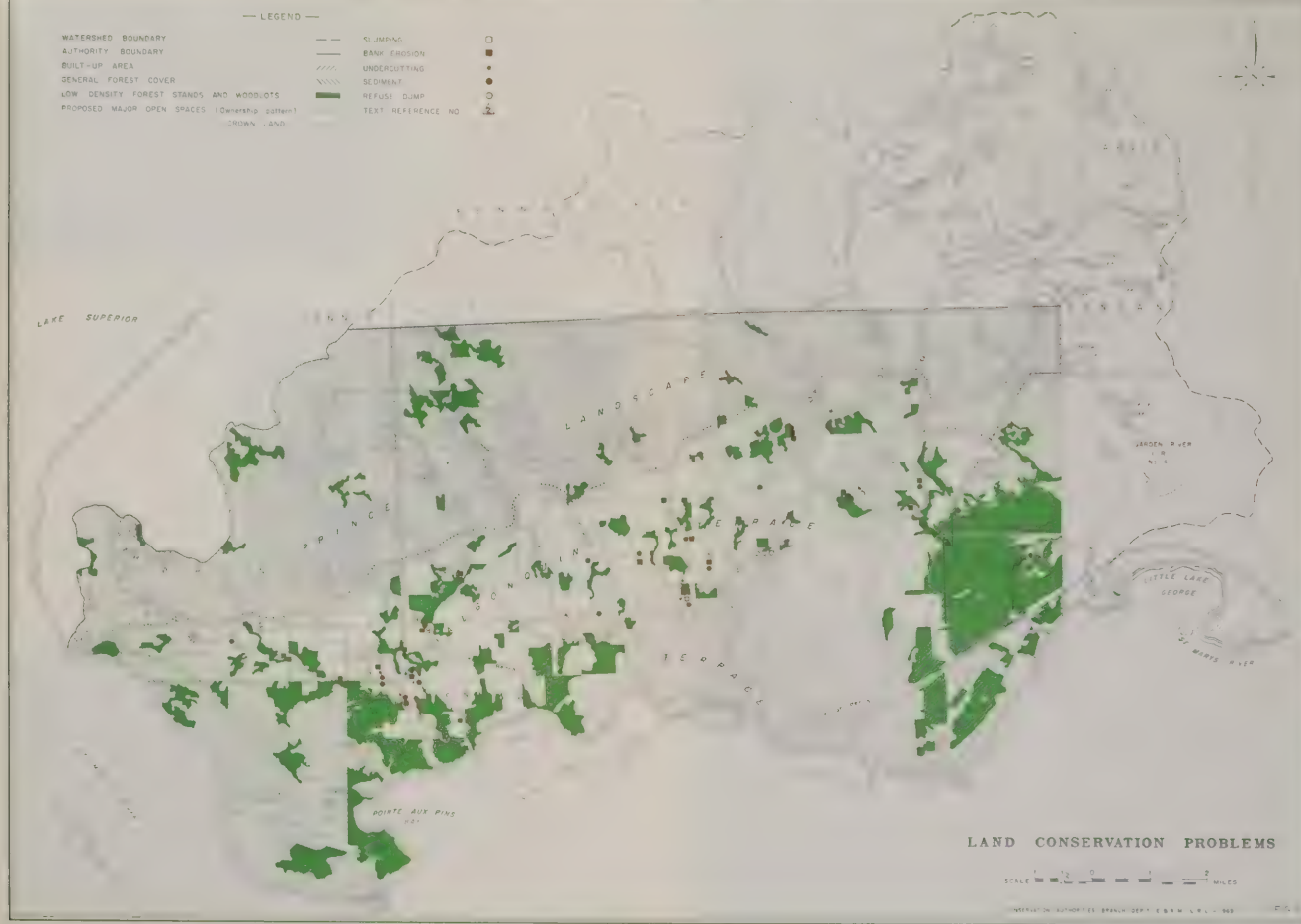
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ST MARYS RIVER
LAND CONSERVATION PROBLEMS
SCALE
MILES

Debris at the junction of Fort Creek and 3rd Line Road.

Debris in the Big Carp River in Lot 33 of Prince Twp.

Storm sewer outfall of subdivision adjacent to north-west corner of the Fort Creek Reservoir Site area.

Stream diversion of West Davignon Creek (at Borden St.) on private property. Note drainage pipe outlet at left.

Bank slump behind new residential dwellings on Whitney St. (Bennet Creek)

Another location of improper land-fill application was evident where the small stream, immediately west of Fairview Crescent (see Ref. No. 6), and adjacent to the south-east corner of Weyerhauser's Lumber Storage Yard, had become completely blocked by the slumping of fill material. The corrugated steel pipes serving as storm sewer outfalls aided the slumpage of the fill material used for the storage yard expansion.

Instances of improper or inadequate fill procedures were noted on private properties along Bennet and West Davignon Creeks in the established residential sectors of the former Korah Township.

6. Erosion

During field investigations of the various streams flowing through the Conservation Authority, numerous examples of stream-bank erosion and its results were quite obvious. The extent of erosion can be related to the soil type that the particular stream may pass through.

The medium sands located in the upper reaches of the Authority are quite readily subject to erosion because of the lack of cohesiveness of the sand particles. As a result stream-bank erosion is prevalent in these soils and the dislodged sand particles are swiftly transported by the stream's current. In the Korah Bench area where the majority of the silty-loam can be located, the degree of stream-bank erosion is quite noticeable. On the Nipissing Terrace the silty clay-loam displays a high cohesiveness and hence is not readily susceptible to erosion. Also on the lower terraces, the stream velocities are generally quite low, thus affording the opportunity for sediment to accumulate.

The three types of erosion studied were: bank erosion, undercutting and slumping (result of the upper bank collapsing when the toe of the bank has been eroded).

When cattle approach streams to drink, their hooves prod the soil and thereby contribute to bank erosion. An example of extensive bank damage by cattle is apparent in the deep gully in Prince Township just north of Highway #550 (see Ref. No. 7). Also, at this location the 80 foot high banks are deeply rilled and extensive bank erosion is apparent. Two other locations (see Ref. Nos. 8 & 9), have been subjected to cattle erosion. In addition, extensive undercutting and slumping along the meandering stream banks have occurred at these two locations. Both of these latter sites have been subject to overgrazing and some large maple trees adjacent to the streams have been toppled by the undercutting.

Other locations of stream-bank erosion have been indicated on the Land Problem Map by the appropriate symbols, and it is advised that the Authority look into the various erosion-prone areas in order to prevent further occurrences or to assist in the undertaking of remedial measures. If there are delays in remedying erosion the resultant sedimentation causes greater problems.

7. Sedimentation

The problem of sedimentation is quite obvious in the lower reaches of the various streams that dissect the Authority's area and it is most noticeable following heavy rainfalls or spring runoffs. Blocked culverts, restricted channel

clearances under bridges and polluted water are only a few of the consequences of sedimentation. In some locations surrounding the Fort Creek Reservoir the soils are quite susceptible to erosion and, hence, the problem of erosion and sedimentation occurring within or near the reservoir site should be considered. Other locations of accumulated sedimentary material are marked on the Land Conservation Problems Map (Fig. 1).

8. Obstruction and Pollution

The last items to be considered in dealing with streams are stream-bed obstructions and pollution problems. Stream-bed obstructions either occur naturally or they are man-made. In either case every attempt should be made to remove these obstructions.

Obstructions in the channels of Bennet and West Davignon Creek in the residential areas between Wallace Terrace and 2nd Line are quite numerous. The following is a partial list of the obstructions: home-made retaining walls of ship-lap lumber, corrugated steel sheets to divert stream flows, private bridge construction and an 8-inch diameter cast iron municipal utility line suspended across the channel of Bennet Creek. In addition to these obstructions there are a number of locations where residential dwellings have been erected too close to the stream channels, an indication that the municipality should implement zoning restrictions (see Ref. Nos. 10 and 11).

The final point to be mentioned, and one that should receive immediate attention, concerns the discharge of pollutants into the streams. Within the residential area previously mentioned, there are a great number of drainage-tile outlets emanating from private dwellings and emptying into the nearby streams (see photo #4). It is recommended that a testing program be carried out in co-operation with the local health unit to determine if pollutants are being discharged into the various streams. The brackish backwaters of the ditches and streams in the vicinity of the slag dumps near Base Line Road should also be investigated.

In summation, the Authority should embark upon a definite stream improvement program to remedy the various refuse dumping problems, bank erosion, sedimentation and stream pollution. The program may consist of a combination of active participation with other bodies, public appeals and promotional programs.

9. Rural Land Use

Much of the land in the rural segments in the Authority is not under agricultural cultivation. In fact most of the farms have become dormant and are used only as places of residence. The few farms that are operated merely provide a secondary source of income for persons who are employed with the industrial complexes. The disparity between farm wages and industrial wages in the area have drawn the younger people away from the farms. Therefore, rejuvenation of the existing farms is not likely.

Isolated family dwellings and strip development have made an imprint on the rural areas and these forms of development are contrary to sound planning policies.

Streambank erosion that will require remedial measures to improve streambanks.

Obstruction of small streambeds by indiscriminate cutting of trees should be prohibited.

10. Gravel Pits

To a large extent the operating gravel borrow pits are located along the upper Algonquin Bench, with the greater concentration of pits located within the extensive terminal moraine which lies partially within the north-east corner of the Authority (see photo #5). A few pits operate close to streams and may require periodic observation to ensure that great quantities of screen washings are not dumped into the streams. In locations where gravel pits have been abandoned, some measure should be taken to regrade the borrow pits. These holes often become refuse receptacles.

A gravel pit located in Lot 16, Korah Twp., typical of the many found along the Lake Algonquin benches.

Car dump located north of Hwy. 550 in Prince Twp., in an abandoned gravel pit.

CHAPTER II

CONSERVATION PLANNING

In analysing the effects of urban expansion on the physical features of the Sault Ste. Marie Region Conservation Authority, the assembled information on the land-use planning function of the Sault Ste. Marie and Suburban Planning Area was examined. In addition, studies revealed certain basic criteria which obviously had been adopted by the local construction and development industry for handling problems of extreme topography. In general, the local construction industry has avoided areas of extreme topography or flood susceptibility for urban expansion of Sault Ste. Marie. In arriving at our recommendations for this report, we have recognized these local development criteria.

Certain lands within the Conservation Authority are already publicly owned and it is assumed that these lands will continue to be used as public open space. In this chapter, recommendations are made for lands which should be preserved as major open space in addition to those lands which are presently so used.

An examination is made of the present planning controls for open space lands in the area covered by the Sault Ste. Marie and Suburban Planning Board. In addition, suggestions are outlined for the types of municipal land-use controls which would best preserve, as open space, those lands which are generally unsuitable for urban development because of flood susceptibility, extreme slopes and dissected topography.

1. Present Land Use (1968)

During the summer of 1968, information was assembled on the existing land use within the Sault Ste. Marie Region Conservation Authority. Three main land-use categories were used: Agricultural and Vacant, Urban Development, and Existing Open Space. Information on all three categories was supplied by the Community Planning Branch of the Department of Municipal Affairs. The Existing Land-Use Pattern is shown in Figure 2.

Within the urbanized portion of the Authority, the existing open space consists of either publicly-owned municipal parks or lands which are privately owned and are free of any urban development because of their extreme topography or flood vulnerability. Although the Sault Ste. Marie area has extensive frontage along the St. Marys River and Lake Superior, little effort has been made to develop this valuable resource for public open space. Much of the shoreline has been taken up either with cottage development or permanent residential and industrial development, both of which prevent public access to the shoreline. With proper land use and development controls, the remaining shoreline can be preserved for the use of the general public.

An examination of the existing land-use pattern in the Authority reveals a substantial random encroachment of non-farm residential development into rural and agricultural areas. Those farm areas closest to the city are undergoing the speculative development that is common in most urban fringe areas of Ontario.

Urban development in the Authority consists mainly of single-family housing and covers only a relatively small portion of the total Authority. A feature of most of the urban development is the apparent lack of attention to certain rugged physical features, such as bluffs and valleys. Rather than using these rugged topographic features to maximum advantage, they have been treated more or less as necessary inconveniences in the path of urban development. As the cost of land in the built-up area increases, the physically less desirable areas are being developed, often with little or no regard for slopes, vegetation or aesthetics. Such recent developments usually take the form of multiple family accommodation. During the summer of 1968, the staff of the Conservation Authorities Branch noted numerous cases of urban encroachment into areas that were in general, physically undesirable for urban development. Such encroachments have created, or have the potential of creating, hazardous situations involving flooding, erosion or landslides. Such observation led to an investigation of the existing planning controls in the City of Sault Ste. Marie and the Township of Prince. This investigation centred mainly on an examination of the controls over urban development in the vicinity of steep-sided valleys, flood plains, shorelines and areas of dissected topography.

2. Present Land-Use Controls

Under The Planning Act of Ontario, the City of Sault Ste. Marie and the Township of Prince are given the power to control the use of private lands through legislative means. Lands within the Rankin Indian Reserve are controlled through the Indian Band in co-operation with the Federal Department of Indian Affairs and Northern Development.

The principal controls available to the municipalities for the control of private land use are Restricted Area (Zoning) By-laws, Official Plans, Subdivision Control and Subdivision Agreements.

a. Official Plans

Pursuant to Sections 10, 11 and 12 of The Planning Act, the City of Sault Ste. Marie, in 1956 adopted an Official Plan. This Official Plan covered only the City of Sault Ste. Marie, although the Sault Ste. Marie and Suburban Planning Area includes the City and the Townships of Tarentorous, Korah, Prince, Parke and Awenge. Later in 1963, the Plan was amended to make land-use provisions for the Township of Tarentorous. A year later similar provisions were made for the Township of Korah. In 1965, the City amalgamated with all these townships except for the Township of Prince, which continued to be part of the Sault Ste. Marie and Suburban Planning Area. Work began immediately on a new Official Plan to cover the expanded City and the Township of Prince.

The new Official Plan for the Sault Ste. Marie and Suburban Planning Area is presently before the Minister of Municipal Affairs for approval. At the request of the Department of Municipal Affairs, the Conservation Authorities Branch of the Department of Energy and Resources Management examined the proposed land-use pattern and policies. Certain specific recommendations were made concerning the suitability for building on some lands within the Planning Area. Those lands lying within the river valleys, as well as lands having extreme slopes or dissected topography, were recommended for designation as


TOWNSHIP OF PRINCE
SAULT STE MARIE CITY LIMITS

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"Major Open Space". The further recommendation was made that any buildings or structures in these areas be limited to those required for recreational purposes or water control. Appropriate policies governing development adjacent to unsuitable building areas were also recommended.

b. Zoning By-Laws

In 1955, the City of Sault Ste. Marie, as it then existed, passed its first comprehensive Restricted Area By-law, commonly known as the Zoning By-law. Numerous amendments have been made in order to meet changed conditions since the original by-law was passed. Unfortunately, the by-law was written during a period in the history of planning in Ontario when the comprehensive type of by-law currently most acceptable was uncommon. In the Sault Ste. Marie Zoning By-law, this means that no special provisions are made for zoning out or setting aside those lands which should be preserved for public open space uses. However, open space uses are included within a broad category of uses permitted in almost any zone. On the Zoning Map, parks, or open space in general, appear as part of the zone, or zones, adjacent to them. Administratively, this is an undesirable situation and can most certainly lead to the intrusion of urban development into unstable slope or flood susceptible areas. Elsewhere in this report reference is made to remedial measures for the bad effects of such encroachments in the past.

Before the 1965 amalgamation with the City of Sault Ste. Marie, the Townships of Korah and Tarentorous were municipalities in their own right although they were within the Sault Ste. Marie and Suburban Planning Area. No zoning by-laws were passed to cover these two townships, and it is only since the 1965 amalgamation that the planning program has progressed to the point of placing zoning controls over these new areas of the City. A comprehensive zoning by-law has been passed by the City of Sault Ste. Marie to repeal all existing zoning by-laws and to extend controls to the enlarged City.

The Township of Prince has only recently submitted a zoning by-law for review by the Department of Municipal Affairs, and this by-law will be such that it will implement the proposed new Official Plan covering the entire Sault Ste. Marie and Suburban Planning Area, of which the Township of Prince is a part.

c. Subdivision Control

Under the provisions of Section 26 (1) of The Planning Act, the City of Sault Ste. Marie and the Township of Prince have passed by-laws which require that all subdivision of land follow the procedure prescribed under The Planning Act. As a condition of subdivision approval it is common to have an agreement between the municipality and the subdivider outlining certain economic or physical conditions which must be adhered to. Such a subdivision agreement affords the municipality the opportunity to impose specific controls over lands which are near areas subject to flooding, erosion, or in general, areas which are unsuitable for building. In suggesting which lands fall into this category and the best types of controls for development near these lands, the Sault Ste. Marie Region Conservation Authority can provide a valuable service to the overall urban development of the Planning Area. At the same time, the

Conservation Authority can safeguard the interests of conservation by keeping itself totally informed of any pending urban development in or near these critical areas. Of course, this implies that the Sault Ste. Marie Region Conservation Authority has up-to-date information on the potentially dangerous sites within its jurisdictional area.

d. Rankin Indian Reserve

The Rankin Indian Reserve lies at the edge of the urbanizing portion of the City of Sault Ste. Marie. There is little doubt that eventually the urban expansion will substantially alter the rural characteristics of the Reserve. Unfortunately, effective liaison between the City of Sault Ste. Marie and the Indian Reserve is difficult, insofar as the control of land use and development is concerned. Land-use planning controls on the Reserve are the responsibility of the Federal Department of Indian Affairs and Northern Development; therefore, municipal or provincial land-use controls and development policies have no legal effect.

In order to guide development of the Rankin Indian Reserve, the report entitled "A Plan for the Rankin Indian Reserve" was prepared for the Indian Affairs Branch of the Department of Indian Affairs and Northern Development, in 1967*. This report outlines a number of alternative development schemes for the Indian Reserve, keeping in mind its potential value for urban development emanating from the City of Sault Ste. Marie. Few problems can be expected with this area as long as it remains undeveloped. However, as the value of property increases in those areas of the Reserve lying adjacent to developing parts in the City, it is reasonable to expect that some lands will be either sold or leased on a long-term basis to non-Indians. Any lands which are sold to private interests will in practice, although not legally, become part of the City of Sault Ste. Marie which surrounds the Reserve on three sides. In this conservation report, we have shown, therefore, those areas abutting the Root River and its tributaries flowing through the Rankin Indian Reserve which should be preserved as open space, free and clear of any buildings or structures. These recommendations are made with the full knowledge that no legal means are available for enforcing this recommendation until such time as any of the lands pass into non-Indian ownership. The Sault Ste. Marie Region Conservation Authority should encourage effective land-use planning in the Indian Reserve, especially along the rivers.

3. Future Land Use

The 1965 amalgamation of Sault Ste. Marie brought sufficient land under the City's jurisdiction to enable the proper long-range planning of urban expansion. The new Official Plan which is currently under review, makes provision for an orderly expansion of this urban area. The demands of such urban development for open space and recreational uses will most certainly necessitate the setting aside of large tracts of land.

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* A Plan for the Rankin Indian Reserve, Sault Ste. Marie, Ontario; Proctor and Redfern, Bousfield and Bacon, Consulting Engineers and Town Planners, December 1967.

Figure 2 shows those lands on the major watercourses in the Conservation Authority which are either subject to flooding, are extremely steep or have a dissected topography. Most of these lands recommended as "Major Open Space" are currently free of urban development and should be set aside in advance of development to provide an inter-connected public open space system encompassing the whole of the Authority. In addition, the open space corridors on either side of the river systems would lead naturally to larger open space and recreation areas like those which will be established around the Fort Creek Reservoir site. School sites could also be tied into this regional park system, providing pedestrian walks in a pleasant setting.

In addition to the lands lying on either side of the river and creek systems, those lands which make up the numerous "bench" and gully-lands have been included in the Major Open Space category because of their unsuitability for building or development.

In any future open space development program, attention should be given to the preservation of unique physical features, for the enjoyment of the general public and tourists to the area. Gros Cap is an excellent example of one such feature. The magnificent view of Lake Superior and the rugged beauty of the Sault Ste. Marie area, from Gros Cap, should be preserved and developed by the Sault Ste. Marie Region Conservation Authority.

4. Recommended Land-Use Controls

This review of planning problems in the urbanizing area of Sault Ste. Marie, as well as the experience of other municipalities, lead to a number of useful recommendations for the control and preservation of open space in the major valleys and the smaller watercourses within the Sault Ste. Marie Region Conservation Authority. Figure 3 illustrates, in cross-section, the features of a typical river valley, and outlines the legislative land-use controls that may be applied.

a. Registered Fill and Construction Regulations

Under Section 26 of The Conservation Authorities Act, 1968, a Conservation Authority may pass regulations for the control of construction and the dumping of fill within specified areas under its jurisdiction. The lands which may be subject to such regulations need not be limited to flood plains, but may include lands which are deemed to require general conservation practice. Included within this category are those lands which lie between the rims of deeply-incised valleys, lands which are generally subject to flooding, lands which have an extreme slope or dissected topography that makes the land unsuitable for urban development, and some lands which lie along the shoreline of the St. Marys River or Lake Superior.

As part of its program within the Sault Ste. Marie area, the Sault Ste. Marie Region Conservation Authority should undertake to delineate those lands which should be protected under fill and construction regulations. As a general guide, all lands which are shown as Major Open Space in Figure 2 of this report should fall under these regulations. More detailed field investigation will be required to locate precisely the limits of the regulated lands. Once the Authority has established these

units, the appropriate regulations should be passed and there should be the fullest co-operation between the Authority and the local municipalities, so that the policies of these administrative bodies may be consistent. Initially, the Authority should make the implementation of regulations a top priority project for the Sault Ste. Marie urbanizing area. The controls could then be extended gradually until they covered the entire area within the jurisdiction of the Conservation Authority.

b. Official Plans and Zoning By-laws

The Sault Ste. Marie Region Conservation Authority should seek the full co-operation of the City of Sault Ste. Marie and the Township of Prince to ensure that adequate policies are contained in the Official Plan and Zoning By-laws to preserve the best open space areas for the general public. In particular, the Official Plan should outline and set aside, under a general category of "Major Open Space" or "Conservation", those areas delineated by the Conservation Authority within the registered fill and construction regulations that have been recommended.

In the Zoning By-law, consideration should be given to the location of buildings and structures abutting any area designated under the registered fill and construction regulations, especially those areas along the major valley systems. The common method of implementing such a control is to include within the Zoning By-law a required set-back from a specific line along the top of a valley. It is suggested that a 40 foot set-back is required, and that no buildings or structures of any type be permitted within this set-back area. The Sault Ste. Marie Region Conservation Authority should co-operate with the two municipalities and the Planning Board in reviewing any proposed amendments or construction in this set-back area before a final decision is made.

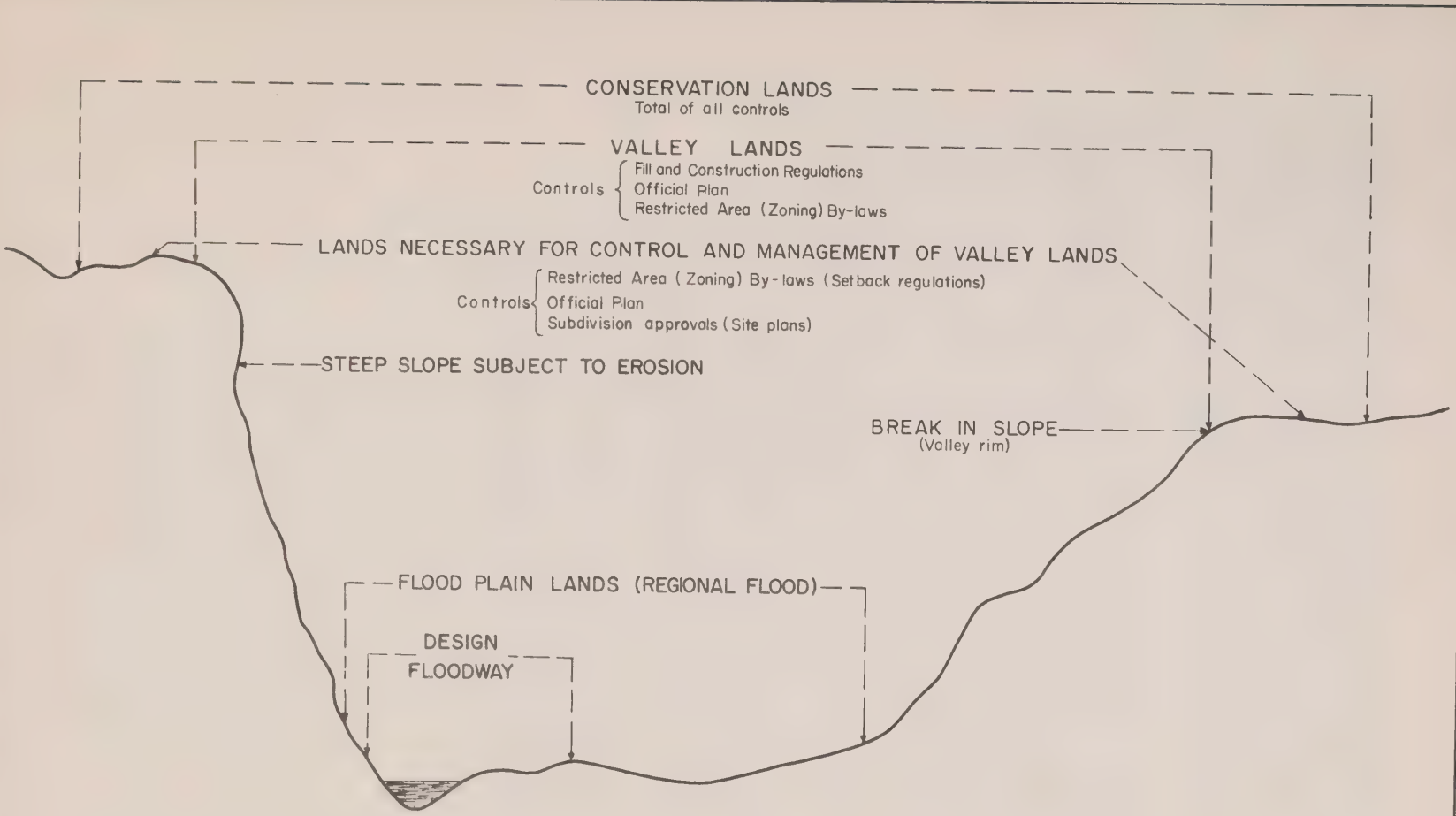
Along the valleys of streams which will flow directly into the Fort Creek Reservoir, a minimum building set-back of 100 feet should be required in the Zoning By-law. Such a set-back would reduce the danger of erosion and, thus, the rate of sedimentation of the reservoir.

In some cases, even where lands may not be designated as "Major Open Space" or be near it, consideration should be given to the slope of this land to avoid landslides or massive erosion. A possible approach, which is in use in some municipalities, is to prohibit any construction on lands having a slope greater than 22 per cent. In addition, no part of the area which has a slope of 22 per cent or greater should be used in calculating the minimum lot area required, or any lot coverages required, under the Zoning By-law.

The purpose of such controls is to ensure that obvious physical problems are faced during the process of development approval, so that adequate warning may be given of imminent dangers to any prospective purchasers.

c. Subdivision Approvals

When private land is to be subdivided, an application is normally directed to the Minister of Municipal Affairs for draft approval. His Department circulates the proposed subdivision to agencies having a vital



TYPICAL CROSS SECTION OF A RIVER VALLEY
AND POSSIBLE LAND-USE CONTROLS

Fig. 3

CONSERVATION AUTHORITIES BRANCH, Dept. E.&R.M. G.G.G. 1968

interest in urban development. Among these is the Conservation Authorities Branch of the Department of Energy and Resources Management. The Branch may comment on those aspects which it considers would have an effect on sound conservation practices — mainly flooding and erosion or land-slide dangers. Even though some of the municipal legislation controlling planning and development may not have the controls outlined in a. and b. (above), these criteria should be used as guidelines in reviewing any subdivision proposals in the Sault Ste. Marie Region Conservation Authority.

In the Sault Ste. Marie area, a steep bluff, the Korah Bench, appears as a prominent physical feature. In some areas this bluff is overgrown with an established vegetative cover, while in other areas it is free of such cover and is badly eroded and gullied. This bench presents a particularly challenging aspect to the control of urban development. The steep face of the bench, and the numerous watercourses which pass over its face, make it subject to substantial runoffs during the spring or in periods of heavy rainfall. As a result, any development at the toe of this slope may be subject to minor flooding or erosion and sedimentation. The face of this bench, as well as the area at the toe of the bench and immediately above it, should be kept free of any buildings or structures, and the vegetative cover that exists should be preserved. However, to minimize any adverse effect of this bench on urban development two possible subdivision design features can be used:

i. Any development at the toe of the bench can be backed onto the area and deeper-than-usual rear yards provided. In addition, a drainage ditch paralleling the toe of the bench can be constructed to conduct any waters to the nearest major watercourse. At the top of the bench the recommended 40-foot minimum set-back requirement should be adhered to.

ii. A street can be constructed between any development and the toe of the bench so that development occurs only on the side of the street opposite to the bench. This would permit run-off waters to be collected in the street's storm sewer system. The disadvantage of this approach is that one side of the street serves no useful purpose in providing access to urban development.

CHAPTER III

FORESTRY

1. Introduction

The influence of urban expansion experienced by the Sault Ste. Marie Conservation Authority has already been described. It is an influence which will probably increase.

In view of this, an Authority cannot justify a long-term program of forest management for timber production. The Authority's interest in forestry, therefore, should be centered on watershed protection.

2. General Forest Description

Forest cover, within the Sault Ste. Marie Region Conservation Authority, lies within the Algoma Section of the Great Lakes-St. Lawrence Forest Region, according to the system of Rowe in "Forest Regions of Canada".

The Hills' System of land description divides the Authority's area between the Thessalon Site District of the Georgian Bay Site Region and the Batchewana Site District of the Lake Temagami Site Region. Hills' System* uses the line, a projection of the exposed rock-faced formation at Gros Cap, the Prince Formation, along the 1,000 foot contour line within the Authority, as a general boundary between these two districts.

For forestry purposes, the Thessalon site is an area containing pockets of lake-laid clay, silt and sand, intimately associated with areas of thinly covered bedrock, ridges of esker and morainic materials. There are no esker formations within the Authority.

Much of this district's bedrock is described as low-base, although large areas of acid igneous and metamorphic rocks are common.

The Batchewana Site District, described by Hills, has valleys that occur so frequently that the generally sloping upland can be considered part of a steeply-sloping "roll" which extends from one valley bottom to the next. The depth to the bedrock is extremely variable, from very shallow on the brow of ridges to 50 feet or more in the valleys.

The predominant forest-tree species, in the Authority, are hard maple and yellow birch. Rowe, however, mentions the incidence of white spruce, balsam fir, ironwood, eastern white cedar and white pine. Lowlands along Lake Superior contain white cedar, tamarack, black spruce and alder. The incidence of red maple, white elm and scattered red oak is also mentioned. All of these species were listed in the Forest Resources Inventory of 1965, which was prepared by the Department of Lands and Forests.

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* Hills, A. "A Ready Reference to the Description of the Land of Ontario and its Productivity".

3. The Inventory of Existing Forest

Frequently the discussion of forest conditions in relation to the conservation of renewable resources centres around the theme of productivity. Hence, species combinations are frequently described on the basis of their desirability as timber, their density characteristics in forest stands and their ability to produce continuous growing stock. Within this context it is also accepted that certain forms of forest cover do exist on unproductive sites, and that these forms are best left undisturbed in order to provide forest cover for the protection of the landscape and the natural community. It is suggested, however, that within the Sault Ste. Marie Conservation Authority, the productivity concept should be supplanted by the concept of the relationship between the cover and its function in conserving landscapes for multiple uses. Hence individual forms of forest cover in this report are discussed within the context of their conservation function.

All the information has been extracted from the Forest Resources Inventory of the Sault Ste. Marie Forest District of 1965. This inventory indicates that only 3.7 per cent of the Authority is Crown-owned. The major block of this land is located at the Sault Ste. Marie Airport, and the rest is in the form of scattered properties.

4. Scrublands

Scrublands are made up of those species that do not attain commercial value because of their low growth and narrow stems. Typically these areas, within the Authority, are in the form of treed muskeg, open muskeg and alder stands. They cover 2,926 acres and 90 per cent of these scrublands are covered mainly with alder.

Much of this scrubland cover occurs as narrow, linear areas next to streambanks and ponds, mostly in the region north and west of the urban area. Generally, this cover maintains the streambank and should be left undisturbed, except in instances where the use of stream sides as recreational areas requires the replacement of the alder with grasses to prevent erosion.

Major areas of alder cover are associated with the wetlands near the Sault Ste. Marie Airport. Any attempt to convert such cover to merchantable species would be useless to the Authority. Such an effort would require major drainage and forest conversion work, only to create cover whose function would be limited by its isolated position.

5. Condition of Forest Lands

The Authority forest area can be divided into two major regions:

a. The northern region, bounded on the south by the Prince formation and an easterly projection from the Prince, along the 1,000 foot elevation contour line; and

b. The area south of this, extending to the shores of Lake Superior and the St. Marys River.

Since the area which was originally cleared for agriculture lies in the southern region, it follows that the principal forest covers almost the entire northern region of the Authority.

TABLE 1. FOREST COVER BY TOTAL AREA OF PRINCIPAL SPECIES (ACRES)

Sugar Maple	Yellow Birch	White Birch	Poplar	Other Hardwoods	Balsam Fir	Spruce	White Pine	Other Conifers
Crown Lands								
943		61		26	74			58
Patent Lands								
16,500	1,207	4,951	1,400	280	6,572	768	428	1,154

Sugar maple forest cover is by far the dominant species, thus conforming to the regional forest description.

The remaining species groups share predictable distribution conditions. The order of dominance begins with balsam fir stands and is followed by white birch, poplar, yellow birch and the spruces.

Of the other species found in the Authority, red oak exists mainly as an occasional merchantable component of some hardwood stands throughout the Authority and as an amenity to cottage and recreation areas in shoreline sections west of Sault Ste. Marie.

Among the conifers, white cedar and tamarack are situated mostly in stand form in the major swamp areas north of the Sault Ste. Marie airport. They are not a commercial entity, nor do they perform any major conservation function, with the possible exception of a limited wildlife benefit, due to their geographic location.

An examination of the age class distribution of all major species in the northern region shows that the bulk of the forests are of intermediate age classes. There is a general lack of young stands and a similar lack of mature and maturing stands. The shorter-lived species such as poplar and white birch are the exceptions.

The distribution of existing age classes of forest, however, illustrates two factors:

a. That manipulation of some stands in the Authority's northern region would be useful to improve the density of regeneration for erosion control purposes; and

b. That the limited, merchantable stand area still evident in the northern region, on privately-owned land, represents a potential for small-scale logging of a type that is an erosion hazard.

During the 1968 examination, the results of one such small-scale operation exhibited this erosion hazard on the upper reaches of the east tributary of the Big Carp River, an area of abrupt slopes and small, incised valleys.

TABLE 4. SUITABLE AUTHORITY TREE PLANTING AREAS

Location	Acreage	Species Suited to Site Conditions
South of the 4th Line, East of Hwy. 17 and along the Root River	68	Balsam Fir
Between 4th Line and Old Garden River Road	44	Balsam Fir
The Little Carp River banks between the Appin Beach Road (Korah Township Area) and Hwy. 550	188	Balsam Fir
Lot 36 of Prince Township area	192	Balsam Fir Soft Maple Poplar White Birch

7. Relationship Between Tree Cover and the Urban Area

It is anticipated that the urban area of Sault Ste. Marie will expand, at first, in an east-west direction.

The development of forest, woodlots, and even individual trees, therefore, depends more on the preferences of property owners, planners, architects, and developers, than those of timber forest managers. Hence the Authority's treatment of these areas must differ from that of the system of management suited to the more heavily forested northern region.

Woodlands with good site conditions, but exhibiting open and sub-normally populated stands of trees are located in the former Parke Township area on the north, south and east sides of the Sault Ste. Marie Airport. It is possible that increasing the stand population would be of some advantage to shoreline cottage areas. However, due to the geographic location of the stands, the justification for the expenditure of Authority funds for land purchases, in the interest of reforestation, appears dubious.

Forest inventory maps also show that a majority of the poorly populated woodlands, containing up to 50 per cent of normal stocking, are situated in areas that have experienced heavy urbanization and the effect of local agriculture. The treatment of such stands under Authority auspices appears unjustified except in those areas with stream banks and valleys where such treatment is vital to overall conservation purposes.

The existence of tree cover on valley sides in agricultural areas, suburban fringes and urban areas, is not a complete conservation measure. Experience has shown wooded slopes are partially controlled by the use of adjacent lands. Hence runoff water coming from agricultural fields and developing urban areas can concentrate in waterways outside the valley, thus wearing rills and gullies through the valley sides. Such waterways are located in the wooded portions of the Fort Creek Watershed system adjacent to the reservoir,

and upstream from it. This type of erosion is a problem for overall land-use improvement or control on lands adjacent to areas which are zoned or maintained for conservation purposes or open space. A similar situation occurs north of the urban Sault Ste. Marie area, east of Highway No. 17. A series of incised waterways and small valleys pass through various woodland forms and grasslands toward the Old Garden Road between the 2nd and 4th Line.

If these waterways are kept intact in the future, as the urban region expands, the planting and maintenance of the trees on the slopes will serve as an amenity to developed areas. The maintenance of the grassed surfaces is equally important for erosion control. Any tree planting should be done by hand in order to minimize the disturbance of ground vegetation.

8. The Effect of Forest Cover on Runoff Retardation

At the Authority's suggestion, some aspects of the effect of forest areas on water yields are discussed in this report. Within the Conservation Authorities of Ontario, rarely do such conditions occur as they do in the Sault Ste. Marie Region Conservation Authority, where the upstream half of each watershed is in a forested state. Hence, an opportunity is presented to explore this particular theme in knowledge of the fact that the effect on water yields of areas cleared by man for roads and farms, is minimal.

This type of research, using the Authority's precise conditions, has never been done in Canada. Hence it is necessary to utilize the results of forest hydrology research that has been performed in the State of New Hampshire under conditions similar to the northern hardwoods forest cover conditions of the Authority.

The principal period of concern covers the months of November through April when precipitation is in the form of accumulated snow, producing runoff water yields in a relatively short time.

Research began (in 1955), in the New Hampshire area which has some resemblance to local forest cover species in the Authority, in two classes of northern hardwood forest. The chief species were white birch, sugar maple, red maple and white ash. The stand types under investigation were pole timber and saw timber classes with average heights of 60 feet and 80 feet respectively. Annual snow falls were also similar to those of the Authority.

Snow accumulations on the ground in each stand were compared with the accumulations in nearby open areas. The open areas generally showed 21 to 28 per cent more snow.

The following table shows the results of the 1955 New Hampshire experiment based on the snowpack measured on March 17th.

TABLE 5. ACCUMULATIONS OF SNOW

	Snow Depth in Inches	
	Open	Forest
Polewood Stand	34.8	25.0
Saw Timber Stand	40.2	31.7

Similar studies have been performed in the Adirondack Mountain region of New York State, 130 miles west-northwest of the New Hampshire experiments. These studies indicated that more snow accumulated under hardwoods than under conifers. However, this snow melted faster so that by mid-April the conifer cover possessed a greater snow-water content, and the conifer snowpack lasted an additional 9 days during the spring runoff period.

In the New York experiments, the snowpack conditions were related to the percentage of forest canopy closure.

TABLE 6. EFFECT OF CANOPY COVER ON SNOW ACCUMULATION

Condition	Canopy Closure (%)	Maximum Snow-Water Accumulation (Inches)
Conifer Saplings	66	7.4
	60	7.8
Conifer Saw Timber	60	7.8
	64	8.0
Hardwood Saplings	28	8.0
	24	8.2
Hardwood Saw Timber	23	8.6
	20	8.4

Of the conifer species studies, the best snow-interception platforms were supplied, in order, by balsam fir, spruce, white pine and hemlock.

The results of similar research in northern Minnesota are also worth noting. These experiments were begun during the winter of 1956-1957, in different stocking levels created by the cutting of red pine, aspen and black spruce stands. The results were similar to those of the experiments in New Hampshire and New York.

TABLE 7. WATER CONTENTS DURING MELT PERIOD (Inches)

	Cover Type				
Date	Open	Natural Aspen	Red Pine 60 sq. ft.	Red Pine 100 sq. ft.	Red Pine 140 sq. ft.
April 11	1.60	3.30	3.10	3.80	4.70
April 22[1]	0	0	.13	.14	1.10[2]

[1] This was the last sampling date when snow was on ground.

TABLE 8. WATER CONTENT UNDER ASPEN STANDS OF DIFFERENT STOCKING LEVELS (Inches)

Date	Basal Area 50 sq.ft.	65 sq.ft.	80 sq.ft.	115 sq.ft.
January 9	1.4	1.3	1.3	1.3
February 5	2.2	2.3	2.2	2.1
February 19	3.0	2.9	3.0	2.3
March 4	3.2	2.9	3.0	3.1
March 22	4.5	4.1	4.2	4.3
March 28	4.3	4.0	4.0	3.9
April 4	3.5	3.2	2.7	3.2
April 11	3.2	2.5	3.5	3.9
April 17 [1]	2.6	2.2	3.1	3.4

[1] This was the last sampling date when snow was on ground.

Table 9 shows the snow depth and water content at the time of the last measurement for areas of aspen (all densities combined), conifers, mixed pine-hardwood, and brush and hardwood, as well as for an open area. Data for a red pine and a jack pine area were combined under "conifers", as differences in water content were minor.

TABLE 9. SNOW DEPTH AND WATER CONTENT UNDER VARIOUS COVER TYPES ON APRIL 17, 1957 (Inches)

Cover Type	Snow Depth	Water Content
Open	0.0	0.0
Brush and Hardwood	6.6	2.0
Aspen	8.1	2.8
Conifers	11.4	3.4
Mixed Pine-Hardwood	13.4	3.9

The mixed, white pine-hardwood stand collected and retained more snow water than any other forest type. The holes in the canopy, formed by the scattered hardwoods, and the flexible white pine needles allowed a large amount of snow to reach the ground. At the same time the white pine provided protection against direct insolation and thus retained more snow for a longer period of time.

9. Management Implications

In the American experiments, certain forest manipulations were conducted in order to compare the results of different management methods. These can be tabled for the period of maximum snow accumulation.

TABLE 10. EFFECT OF FOREST MANIPULATION EFFORTS ON SNOW-WATER CONTENT

Area	Date	Management Method	Snow-Water Content (Inches)
New York State	Mid-March	Forest Road, Semi-open	9.68
New York State	Mid-March	Commercial Clear Cut	9.25
New York State	Mid-March	Selective Cut 23-35 Year Cycle	10.08
New York State	Mid-March	Selective Cut 15-20 Year Cycle	10.12
New York State	Mid-March	Selective Cut 5-10 Year Cycle	9.30
Minnesota Black Spruce	March 29	Clear Cut Strip	4.3
Minnesota Black Spruce	March 29	Single Tree Selection	3.2
Minnesota Black Spruce	March 29	Uncut Unit	2.7
Minnesota Black Spruce	March 29	Shelter Wood	3.5
Minnesota Black Spruce	March 29	Open Patch	4.0

The results of both the Minnesota and New York State experiments can be quoted.

> "Although the forest plays a complex role in snow accumulation and melt, it basically does two things. First, it acts as a barrier to snow accumulation. It decreases the amount of snow which reaches the ground by intercepting the falling snow. The heavier and denser the crown, the more it intercepts and less is caught in the area. The thinner the crown, the less it intercepts and more reaches the ground.
>
> "Second, after snow has reached the ground, the same factors operate but their effect is reversed. The thicker the crown, the less sunlight and wind movement and the slower the rate of snowmelt. The thinner crown, which permitted more to reach the ground, offers less protection against sun rays and wind movement, and snow disappears more rapidly.
>
> "Considering these factors, it is logical that the pattern of snow accumulation and melt in this study behaved as follows:
>
> 1. All open fields lost snow earlier and faster than forested areas.

2. More snow accumulated in the hardwoods, but conifers retain it longer.

3. Stand density and conifer types influence, to some degree, the amount of snow accumulation and the rate of melt. Lightly stocked stands caught more snow; dense stands retained it longer.

4. The pattern of cut-in conifers also affected snow accumulation and melt. East-west strips caught the most snow and retained it longer than any other treatment.

5. Stocking levels in hardwoods affect snow accumulation and melt in the same way as they do in softwoods, but differences are smaller.

6. Mixed stands of scattered conifers and hardwoods (white pine - hardwoods) are intermediate in their reaction with pure conifers and pure hardwoods. They catch more snow than pure conifer stands and retain it longer than hardwood stands, both very desirable features."*

Forest researchers, concerning themselves with management problems in areas close to the Authority where forest conditions are similar, have expressed some doubt about the justification of increasing the conifer content of local hardwood forests, solely on their timber values alone. If the added conifer content increases watershed benefits close to a metropolitan area, however, Authority investigation of this treatment is justified.

The feasibility of certain forms of forest conversion have also been tested by federal researchers using white spruce and white pine in the Goulais River Research Area, 45 miles north-east of Sault Ste. Marie. ** This research indicated that the most economical and effective method of establishing these two conifer species in hardwood stands was to scarify the ground (in strips wide enough to permit two rows of trees to be planted) by bulldozer. The long, narrow nature of many of the Authority's small watersheds may subject them to erosion if this practice is implemented; therefore, caution is advised.#

10. The Application of Forest Hydrology Research

The results of the American research show that forest cover can be manipulated to produce advantageous snow and runoff effects. However, because of the differences in forest cover conditions in the Authority to those of the American research areas, the precise application of the research results to the Authority is not possible.

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* Snow Behavior in Forests of Northern Minnesota and Its Management Implications, Sidney Weitzman and Roger R. Bay, Published Station Paper No. 69, Lake States Forest Experiment Station (M. B. Dickerman, Director), Forest Service, U. S. Department of Agriculture, January 1959.

** An Underplanting Experiment with White Pine and White Spruce Seedling and Transplant: B. S. P. Wang and K. W. Horton; Reprinted from the Forestry Chronicle, Vol. 44, No. 4, August 1968.

Forest Cutting to Increase Streamflow in the White Mountains: George Hart; Published publication North-eastern Forest Experiment, Forest Service, U. S. Department of Agriculture, Durham, New Hampshire, p. 3.

Before attempting manipulation of local forests to attain suitable snow effects, a program of systematic snow measurement at specific sites is necessary. These measuring stations, or snow courses, should be located in a variety of forest cover types.

11. Forest Areas Related to Watershed Protection

The key properties most concerned with protection of the stream systems of the Authority's northern region are shown on Figure 1. These properties are closely related to the corridors termed "Major Open Space" in the Conservation Planning Section of this report.

A major Authority program of systematically purchasing these properties to curb landscape disturbances would involve the acquisition of more than 12,000 acres of land. Since each stream is controlled by a separate group of properties, reliance on land acquisition would mean massive purchases in a short period of time to provide overall control in sufficient time to satisfy the needs of the Authority. The creation of restricted zones, therefore, is likely to be the most effective alternative.


WATER

Crystal Falls in the Hiawatha Park Crown Game Preserve is one of the most spectacular natural features in the Sault Ste. Marie Region Conservation Authority.

CHAPTER IV

INTRODUCTION

1. Review of Previous Studies

During the past eight years, several water resources studies have been undertaken in the Authority. These have proved useful, since they have provided background information and pinpointed problem areas for the recent conservation survey. Most of these reports dealt with the Fort Creek Watershed in the central part of Sault Ste. Marie. In this area, severe flooding problems had occurred with increasing regularity due to urbanization and the resulting increase in direct runoff from rainfall.

As a consequence of previous investigations, the Authority initiated two projects in 1968 as a first step toward the control of the many watercourses that flow through the city's developed area. Both the Fort Creek Dam and the Clark Creek Channel Improvement are scheduled for completion in 1969. The Appendix gives a list of the water resources reports which have been used in the preparation of this report.

2. Field Reconnaissance Survey

In September of 1968, at the request of the Sault Ste. Marie Conservation Authority, a field reconnaissance was undertaken by the Conservation Authorities Branch of the Ontario Department of Energy and Resources Management. One of the most significant purposes of this investigation was to assess the magnitude of, and recommend solutions for, the water-resource problems in the Authority. Interviews and discussions were held with members of the Authority, the city engineer for Sault Ste. Marie, consulting engineers and various other individuals with knowledge of the natural resources and problems of the area. The field reconnaissance covered the major watercourses: areas prone to flooding and erosion were examined. Some potential reservoir sites and all accessible controls on the watercourses were investigated.

3. Report Outline

Steps taken in analyzing the water problems and finding solutions to them are treated in a separate chapter of the report in the following manner:

a. Definition of the Water Resources Management System

This stage consists of an identification of the individual watersheds within the Authority. Factors influencing the operation of the system such as physiography, climate, hydrology and boundaries are discussed in a general manner.

b. Description of the Elements of the Water Resources Management System

The second stage in the analysis is to determine the elements of the system and to describe their interrelationship. The major elements

are: water demand, water supply, water management, water problems and watershed hydraulics. The basic problem is to reconcile supply and demand through proper management of the system's water and land resources.

c. Establishment of Water-Resource Objectives

The third stage in the analysis is concerned with the establishment of goals and objectives, and the relationship of Authority projects and programs to these objectives.

d. Achievement of Water-Resource Objectives

The final stage in the design of the system deals with the means of achieving the water-resource objectives of the Authority. It also involves consideration of alternative solutions to the water problems in an attempt to attain the optimum use of water resources.

SAULT STE. MARIE REGION CONSERVATION AUTHORITY

WATER RESOURCES MANAGEMENT SYSTEM

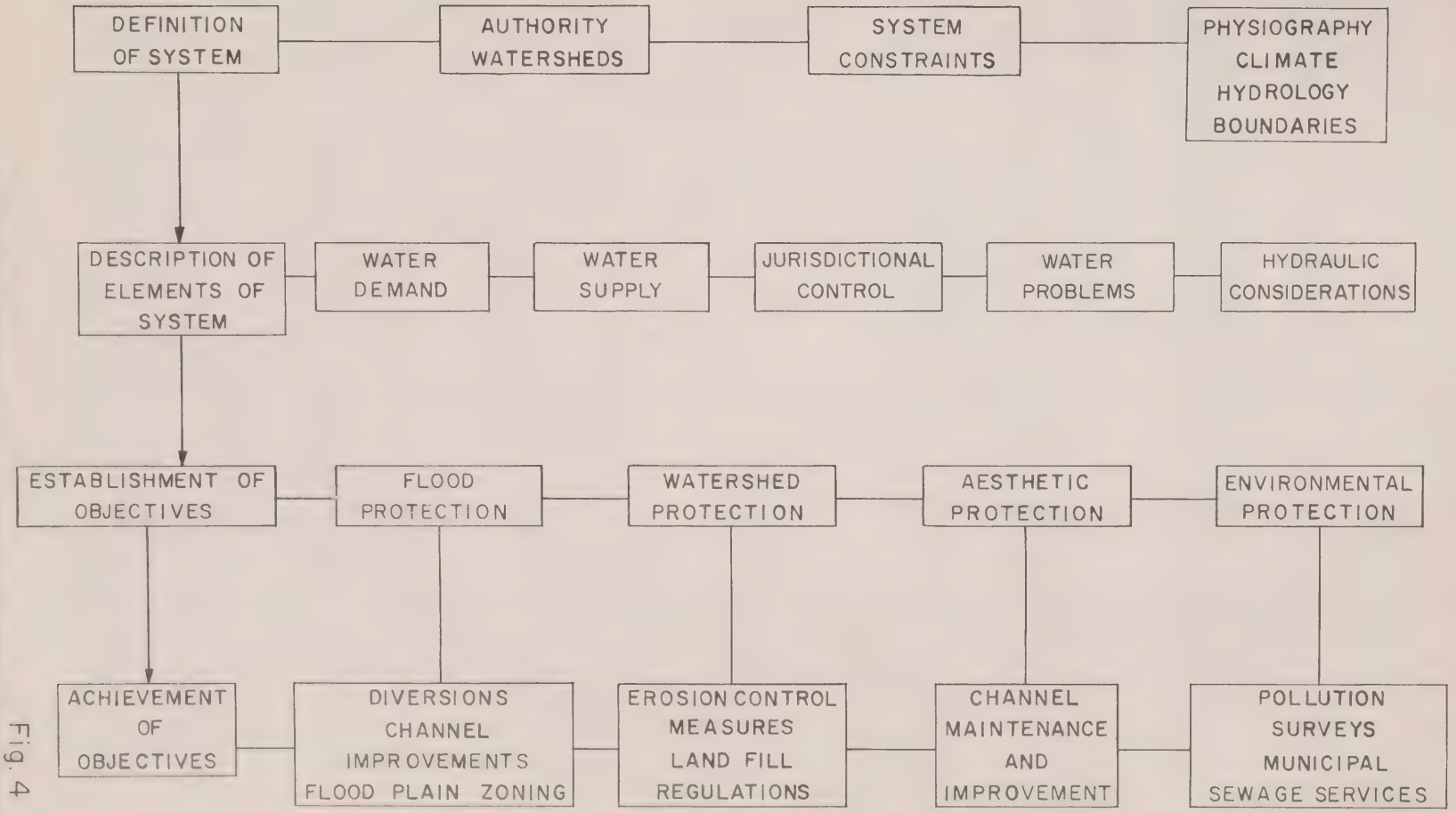


Fig. 4

CHAPTER V

DEFINITION OF THE WATER RESOURCES MANAGEMENT SYSTEM

In defining a water resources management system, the first step is to define the system in terms of the individual drainage basins and the constraints such as physiography, climate, hydrology and boundaries on those basins.

1. Description of Drainage Basins

There are ten major drainage basins in the Authority and most of them have remarkably similar hydraulic characteristics. With the exception of the smaller basins all of them have their headwaters on the high land to the north and flow south to the St. Marys River through the lower terraces.

Table 11 gives a summary of important characteristics for each of these drainage basins. The following is a brief description of the major features of the watercourses.

a. Big Carp River

The Big Carp River is the first major watercourse east of Lake Superior. Originating at Walls Lake, at an elevation of 1,025 feet, in heavily forested terrain, it flows in a south-easterly direction until its confluence with a five-mile-long easterly tributary, about one-half mile south of Highway 550, and then flows south to the St. Marys River, just east of Carpin Beach.

The east branch's headwaters are farther north than the main branch but they are at approximately the same elevation. About 80 per cent of its length is on the Prince Landscape Unit. Runoff from each stream gives sustained flow, south of the confluence, in the lower area south of the Base Line. These flows, in combination with high water levels in the St. Marys River, have caused serious flooding problems near the mouth of the Big Carp River.

b. Little Carp River

The Little Carp River is about 7-1/2 miles long with its headwaters located at a small 4-acre lake north of the Third Line. It flows south through a steep valley to the Second Line. From here it meanders through the terraced lowlands, coming quite close to the Big Carp before discharging to the St. Marys River.

c. Leigh Bay Creek

Leigh Bay Creek is the first watercourse on the western fringe of the urban area of the city of Sault Ste. Marie. It originates in a flat, low area, north of the Second Line, and flows in a south-easterly direction across the Second Line Road and Leigh Bay Road. The crossing of the creek at the Base Line appeared to be partially blocked during the field survey. South of the Base Line the creek flows through private property into Leigh Bay.

TABLE 11. PERTINENT FEATURES OF WATERSHEDS

Watershed	Area (sq. miles)	Average Slope (ft./mile)	Length of Main Creek (miles)	% of Area on Prince Landscape Unit	% of Area on Algonquin Terrace	% of Area on Nipissing Terrace
Big Carp River	19.5	58.8	7.9	65	27	8
Little Carp River	9.2	54.9	7.5	56	24	20
Leigh Bay Creek	3.1	38.0	3.3	5	70	25
Bennet Creek	9.1	84.7	9.2	70	18	12
West Davignon Creek	6.3	78.5	7.0	60	30	10
Central Creek	2.0	28.5	2.3	0	50	50
East Davignon Creek	7.8	73.8	6.1	35	45	20
Fort Creek	4.5	41.1	4.8	0	80	20
Clark Creek	2.3	17.5	2.0	0	5	95
Root River	81.3	41.9 (West Branch)	14.3 (West Branch)	76	12	12

Big Carp River at outlet to St. Marys River, looking upstream.

Mouth of Leigh Bay Creek, typical of St. Marys River shoreline immediately west of the city of Sault Ste. Marie.

d. Bennet Creek

The Bennet Creek drainage basin originates in a large marshy area and flows in a south-easterly direction for a distance of nine miles to its confluence with West Davignon Creek just south of Wallace Terrace in the City of Sault Ste. Marie. The profile in Figure 5 indicates that the watercourse has a gentle slope in the headwaters area and drops abruptly into the lower terraces and the city. The flow is restricted downstream by many road-crossings through subdivisions in the west end of the city before it meets West Davignon Creek.

e. West Davignon Creek

West Davignon Creek is about seven miles long. It originates on the Shield and its main source is Allard Lake near the Fifth Line of the city of Sault Ste. Marie. It flows south to the developed area of the city at the Second Line and thence in a south-easterly direction through the west end of the city as far as Goulais Avenue where it turns west along Wallace Terrace to its confluence with Bennet Creek. Similar problems exist in the downstream areas of West Davignon and Bennet Creek. It is convenient to consider them together to achieve adequate flood control in the west end of the city.

f. Central Creek

Central Creek is almost entirely within the urban area of the city, extending to the Prince Landscape Unit. It has a total drainage area of about 2 square miles, most of which is zoned as residential and industrial on the city plan. The watercourse starts near the intersection of Moss Road and the Third Line and flows south to a continuous concrete box aqueduct at Wallace Terrace, through which it flows until final discharge to East Davignon Creek on the property of Algoma Steel near the Base Line. The aqueduct is undersized, unable to allow the passage of flows greater than 200 c.f.s., and some form of relief is necessary to prevent flooding.

g. East Davignon Creek

East Davignon Creek has its headwaters just north of the municipal limits of the city. Nettleton Lake, about 30 acres in area, is located on the main branch at the Fifth Line. The watercourse flows south, through a deep ravine to the second crossing of the creek by the Algoma Central Railway north of Rossmore Road. South of Rossmore Road the creek flows through a residential area whose development, in some cases, is quite close to the watercourse. Flood damage is possible if the channel capacity is exceeded. Just south of the Second Line the creek enters a continuous concrete aqueduct which carries it all the way to Wallace Terrace where it passes through the property of Algoma Steel before discharging to the St. Marys River.

h. Fort Creek

The Fort Creek drainage basin extends over 4.5 square miles, in the central part of the city. It originates near the Fifth Line and flows south to the St. Marys River. There are numerous references to the hydrology of Fort Creek (see Appendix). A detailed description of the basin may be obtained. For the purpose of this report it is assumed that the construction of the Fort Creek Dam will alleviate the worst problem in the watershed, flooding in the central part of the city.

i. Clark Creek

The Clark Creek drainage basin is situated in the south-east part of the city in an area consisting of residential development and the Sault Ste. Marie Golf and Country Club. Frequent flooding has occurred as a result of the flat terrain in the lower half of the watercourse and the poor condition of the creek channel. Construction of the Clark Creek Channel Improvement Project, started by the Authority in 1968, should solve this problem. The total length of the watercourse is about two miles and it has an average basin width of one mile.

j. Root River

The Root River Drainage Basin, about 70 per cent outside the boundary of the Authority, is the largest of the Authority's watersheds. The drainage system originates in the high lands to the north in a series of small lakes, swamps and bogs. It feeds three main tributaries: the Root, the West Root and Crystal Creek. The West Root drains the western portion of the basin and joins the main river west of Highway 17 near the Root River Golf Course. Crystal Creek headwaters are in the north-eastern portion of the basin and the creek joins the main river near the eastern boundary of the Rankin Location Indian Reserve, about one mile north of Highway 17. The Root River discharges to the St. Marys River at Bell Point on Little Lake George.

The northern part of the basin has been extensively logged in the past. There is sparse development north of the Fifth Line with the exception of numerous summer cottages and resorts which are located chiefly on Upper Island Lake in the north. In the south, the Rankin and Garden River Reserves occupy most of the drainage area. The lower reaches of the Root River basin are flat but well drained and flooding is not a major problem.

2. System Constraints

a. Influence of Physiography

As they are described in Chapter I, the three distinct physiographic regions which divide the Sault Ste. Marie Region Conservation Authority in an east-west direction are the Prince Landscape Unit, the Algonquin Terrace and the Nipissing Terrace. Most of the larger watercourses in the Authority have their headwaters on the Prince Landscape Unit and flow south through the Algonquin and Nipissing Terraces before discharging to the St. Marys River.

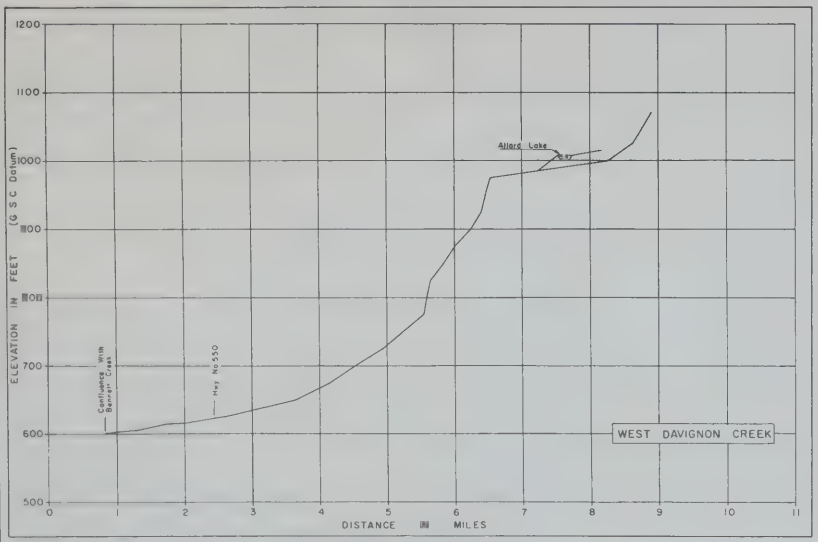
There are many small lakes in the Authority. The largest of these are Walls Lake near Gros Cap, and Allard and Nettleton Lakes about five miles north-west of the city of Sault Ste. Marie. These lakes, as in other glaciated regions, owe their existence largely to blocked drainage channels.

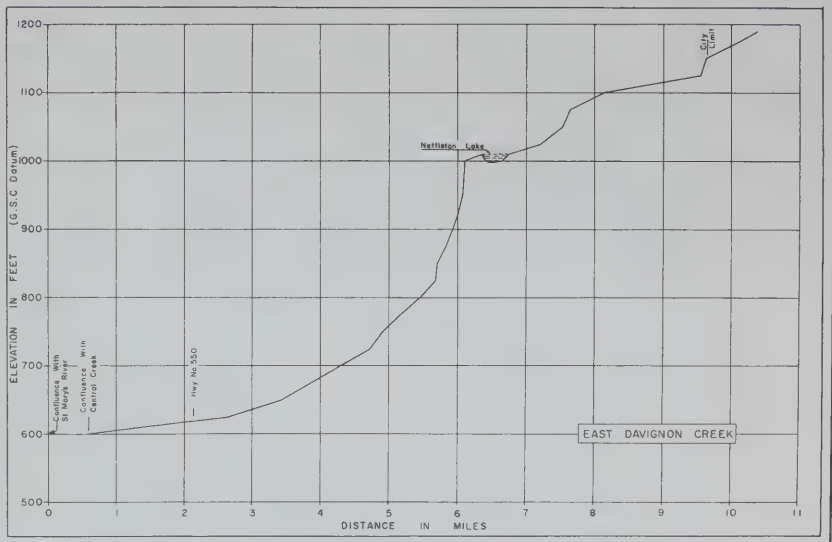
There are ten principal streams and rivers in the Authority. Crystal Creek, the east branch of the Root River, and the east branch of the Big Carp River, cascade down the escarpment in a series of

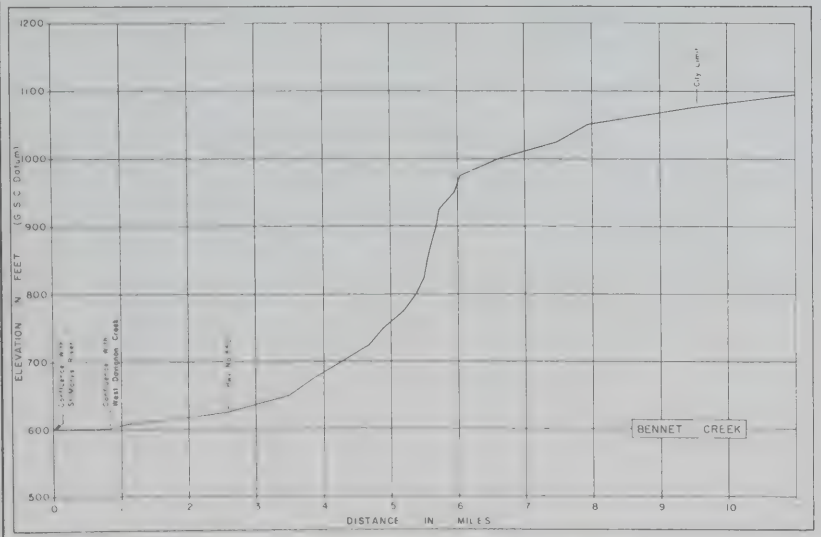
Stream headwater area on the Prince Landscape Unit.

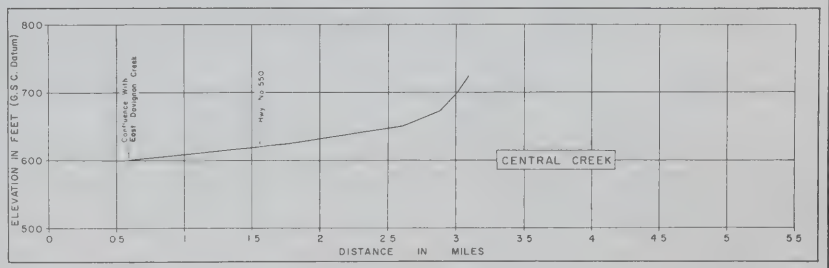
Typical stream on the Algonquin Terrace. Note steeper gradient and gravel banks.

Stream on the Nipissing Terrace.









WATER LEVEL PROFILES

SAULT STE. MARIE REGION

DEVELOPED FROM 1/25,000
TOPOGRAPHIC MAPS
SCALES AS SHOWN

Fig. 5

CONSERVATION AUTHORITIES BRANCH Dept E.&R.M., W.A.C. 1968

TABLE 12. SUMMARY OF TEMPERATURE AND PRECIPITATION DATA

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
SAULT STE. MARIE A	Latitude 46 29 N				Longitude 84 30 W				Elevation 620 ft. ASL				
Mean Daily Temperature (Deg. F.)	16.2	15.5	23.4	37.3	49.5	59.2	63.4	62.8	54.8	46.2	32.8	20.8	40.2
Mean Daily Maximum Temperature	24.8	24.8	32.8	46.4	61.0	71.5	75.5	74.4	65.3	55.4	39.5	28.4	50.0
Mean Daily Minimum Temperature	7.6	6.2	14.0	27.9	38.0	46.9	51.3	51.1	44.2	37.0	26.1	13.2	30.3
Maximum Temperature	45	46	70	79	89	94	99	97	96	82	71	58	99
Minimum Temperature	-42	-39	-34	-20	16	22	27	26	17	10	-27	-34	-42
Mean Rainfall (Inches)	0.56	0.73	1.08	2.04	2.78	3.50	2.80	3.10	4.39	3.27	2.53	0.72	27.50
Mean Snowfall	27.4	23.7	16.2	2.6	0.2	0.0	0.0	0.0	0.1	1.3	14.7	27.8	114.0
Mean Total Precipitation	3.30	3.10	2.70	2.30	2.80	3.50	2.80	3.10	4.40	3.40	4.00	3.50	38.90

picturesque falls, bearing witness to the usual disorganization of the drainage system during the glacial period. Crystal Falls, in the Hiawatha Park Crown Game Preserve, is perhaps the most spectacular natural feature to be found on any of the watercourses. The smaller streams generally have headwaters in lakes or marshy areas and flow south through more uniformly graded channels.

b. Climate

The climate of an area depends on its location within the world-wide circulation of the atmosphere, but the influence of this circulation is modified by the physiographic features of the area.

Climate is the sum of past weather experiences. The conditions of temperature, moisture and light tend to be repeated seasonally since they are controlled mainly by the sun, the seas and the land contours. The local climate also may be profoundly affected by the proximity of water and local topographic relief. This is the situation in the Sault Ste. Marie Region Conservation Authority which is bounded by the St. Marys River to the south, Lake Superior to the west and the higher relief of the Precambrian land mass to the north. The area has a more temperate climate than most of Northern Ontario.

Warm summers and cold winters are particular features of the temperature regime in the Authority. The average annual temperature is 40° F. February, the coldest month, averages 15°, and July, the warmest, 63°. The temperature extremes for this area are 42° below zero and 99° above zero.

The mean annual frost-free period is about 110 days. The average date of the last spring frost is early in June while that of the first autumn frost is in the latter part of September.

The mean annual precipitation over the Region, expressed as water equivalent is 39 inches. The average rainfall is about 28 inches and the snowfall about 115 inches. The monthly precipitation ranges from two to four inches, the lower values occurring in the late winter and spring and the higher values during the fall.

Table 12, showing detailed weather data at the Sault Ste. Marie Airport, is indicative of the values prevailing throughout the Region.

c. Hydrology

Hydrology is the study of the occurrence and the movement of water above, on and below the earth's surface. The circulation of water in its various forms, from the earth to the atmosphere and back again, is known as the hydrologic cycle.

Only that phase of the hydrologic cycle which begins when rain and snow is deposited on the watershed and ends when the water is evaporated into the atmosphere or discharged out of the area as streamflow, will be considered here. The hydrology of small watersheds has been the subject of intensive research for many years and the mechanism of water transport through this phase of the cycle is well understood. However,

engineering hydrology requires the measurement of parameters such as streamflow, precipitation and temperature, among others. Since streamflow records were not available for the small drainage basins within the Authority, it was found necessary to utilize precipitation data in order to arrive at an estimate of the peak flows to be expected in each watercourse under conditions of heavy rainfall.

The design of any river structure requires a knowledge of the maximum flows expected to pass through or around the structure. The determination of flood flows for design purposes is generally based on the selection of one of three design floods.

i. 100-year Flood

An 100-year flood is the flood resulting from an 100-year storm, i.e. the largest storm which is expected to occur once in a hundred years. The probability that this flood will occur in any one year is one per cent.

Table 13 shows design flood flows which could result from the 100-year storm on some of the watercourses in the Authority at key downstream locations. Flows were calculated by using the unit hydrograph concept outlined in the United States Bureau of Reclamation's text on "Design of Small Dams", and the classical Rational Method.

ii. Regional Flood

A regional flood is a flood resulting from the most severe storm known to have occurred over a climatologically similar area. In southern Ontario, Hurricane Hazel of 1954 is adopted as the regional storm for this type of flood; while in northern Ontario the Timmins storm of 1961 is used.

iii. Maximum Probable Flood

A maximum probable flood is the greatest flood that may be expected from the most severe combination of meteorological and hydrological conditions considered possible in the watershed.

The determination of flood flows, resulting from a high-intensity storm, will require an interpretation of the effect of the physiography on runoff. The creek profiles in Figure 2 indicate that Bennet Creek, West Davignon Creek and East Davignon Creek have headwaters on high land in the north and drop abruptly into the lower terraces and city of Sault Ste. Marie. This "double-slope" effect will generally cause a retardation in the peak flow due to a high-intensity short-duration rainfall, possibly giving rise to a more sustained, but reduced-flow, hydrograph. This phenomenon was observed during the course of the field reconnaissance. For this reason, the maximum flow from a storm similar to the Timmins storm, would be somewhat less for these watercourses than would be expected from a typical "single-slope" watercourse of the same size. The calculations of the design flow, considering both slopes separately and a single slope as the average of both, verified this.

TABLE 13. DESIGN FLOOD FLOWS — 100 YEAR FLOOD

Watershed	Location	C.S.M. (c.f.s. per sq. mile)	Design Flow (c.f.s.)
Big Carp River	At St. Marys River	150	2,900
Little Carp River	At St. Marys River	150	1,380
Leigh Bay Creek	At Leigh Bay	260	805
Bennet Creek	At confluence with West Davignon Creek	145	1,320
West Davignon Creek	At St. Marys River	165	1,040
Central Creek	At confluence with East Davignon Creek	260	520
East Davignon Creek	At St. Marys River	150	1,170
West Root River	At confluence with main branch of Root River	125	1,250

d. Boundaries

Boundaries affecting the Sault Ste. Marie Region Conservation Authority may be classified as natural and artificial. Natural boundaries enclose each drainage basin according to the physiography of the system. The actual Authority boundary outlines the area under the jurisdiction of the Conservation Authority and a political boundary separates the Township of Prince and the municipality of the City of Sault Ste. Marie.

i. Natural Boundary

An understanding of the hydrology of the water-resource system is essential for proper resources management. Since hydrologic calculations are based on the watershed area, the natural boundaries, or watershed divides, are of prime importance in the definition of the system. In the Sault Ste. Marie Region Conservation Authority there are three major watersheds located partially outside the Authority boundary. These are the headwater areas of Bennet Creek and West Davignon Creek, and large sections of the Root River watershed shown in Figure 6.

ii. Artificial Boundary

The Authority boundaries and the political boundaries define the conditions for the financial participation of the municipalities in the area.


— LEGEND —
WATERSHED BOUNDARY
AUTHORITY BOUNDARY
INTERNAL DRAINAGE BOUNDARIES
BUILT-UP AREA
AQUEDUCTS
FLOOD CONTROL RESERVOIR UNDER CONSTRUCTION
CHANNEL IMPROVEMENT UNDER CONSTRUCTION
PROPOSED DIVERSION
EXISTING WEATHER STATION
EXISTING DAMS
SUPERIOR
DENNIS
SAULT STE MARIE CITY LIMITS
LANDSCAPE
TERRACE
PRINCE
ALGONQUIN
LITTLE LAKE
LEIGH BAY
SURFACE WATER RESOURCES
SCALE — MILES
½ 0 1 2
CONSERVATION AUTHORITIES BRANCH, DEPT. E.&R.M. L.R.L. - 1968
FIG. 6

CHAPTER VI

ELEMENTS OF THE WATER RESOURCES MANAGEMENT SYSTEM

1. General

The next step in the analysis of the water resources management system is to determine and describe the elements of the system and their interactions and interrelationships. These elements are generalized and are applicable to any water-resource system. However, the detail of each component is directly related to its importance in the Sault Ste. Marie Region Conservation Authority.

2. Water Demand

The demand for water may be categorized as an output of the system, under the following headings: a. Withdrawal, Consumptive Demand; b. Non-withdrawal, Non-consumptive Demand; c. Retardation or Withholding Demand. Figure 7 shows all the demands for a system classified by these three outputs.

The components of the outputs are not necessarily exclusive of each other. For example, the demands for flood control and municipal water supplies may be complementary insofar as they can both be satisfied by one project. On the other hand, components of the same output may be conflicting demands. For example, the demand for recreation is not always compatible with summer flow augmentation since recreation requires a relatively constant water level while reservoir operations for summer flow necessitate water level fluctuations.

a. Withdrawal, Consumptive Demands

Withdrawal consumptive demands are those outputs of the system that involve the movement of water from one place to another, either inside or outside the drainage basin. This category includes use of surface or ground water for municipal, industrial and agricultural demands.

i. Municipal Demand for water from the city of Sault Ste. Marie is satisfied by the St. Marys River. The availability of water is not a problem but the potential upstream sources of pollution may necessitate the acquisition of water from Lake Superior.

ii. Industrial Demand for water in the Authority is met by the municipal system for industries in the city or by individual water supply systems.

iii. Agricultural Demand for water consists of rural domestic and rural irrigation requirements and is satisfied by local sources of ground and surface waters. Owing to the short duration of the growing season, agriculture is not as prominent in this area as it is in southern Ontario.

b. Non-withdrawal, Non-consumptive Demands

Non-withdrawal, non-consumptive demands are those outputs of the system that do not involve the removal or transport of water from one place to another in the Authority. This category includes the following demands: watershed protection, recreation, fish and wildlife, aesthetics, water quality, hydro power and navigation.

i. Recreation Demand should be considered in any multi-purpose water development. Detailed investigation of recreation is outside the scope of this report. However, it was noted that there is a lack of recreation facilities in the Authority and such areas as the Hiawatha Park could be developed like conservation areas in other Authorities.

ii. Fish and Wildlife Demand sufficient water of good quality for the preservation of their natural habitat. Good quality water is prevalent throughout the Authority outside the developed areas of Sault Ste. Marie.

iii. Aesthetic Demands for water are those public requirements for the preservation of the natural beauty of a watercourse. This is especially important in Sault Ste. Marie where streams flow through subdivisions in the city.

iv. Hydro Power Demand does not exist on any of the water-courses in the Authority.

v. Navigation Demand does not exist on any of the water-courses in the Authority.

c. Retardation or Withholding Demands

Retardation or withholding demands are those outputs of the system that require retardation and storage of the water in a stream during periods of high runoff for release during periods of lower runoff. Flood control and flow augmentation are the major items in this category.

i. Flood Control Demands exist, in various degrees, in almost all downstream areas of the Authority. Flooding has occurred regularly for many years in the city of Sault Ste. Marie. The Fort Creek Dam and Reservoir will reduce the hazard in the oldest part of the city, and the Clark Creek Channel Improvement Project will solve flooding problems in newer areas in the east end of the city. The need for flood control measures in the western watersheds of East Davignon, Central, West Davignon and Bennet Creeks will be discussed more fully in the section on "Watershed Hydraulics".

ii. Flow Augmentation Demands result from drought conditions. Adequate streamflow is necessary for aesthetic reasons since a fast flowing creek is always more attractive than a sluggish one, and for the transport and dilution of waters. Large quantities of fast flowing water are necessary to satisfy the oxygen demand of pollutants.

3. Water Supply

Seasonal variations in water supply give rise to imbalances in the system; hence, a basic problem of water resources management is to anticipate these imbalances and recommend solutions for the problems that arise from them. Excess precipitation, for example, will cause flooding problems in many parts of the Authority. The water resources system must anticipate this over-supply of water on the basis of past experience or by hydrological calculations of maximum flows under given storm conditions.

A supply classification is depicted in Figure 7. The origin of the water supplied to the system is precipitation — rain and snow — which is deposited over the land area of the Authority and finally appears in the form of ground or surface water.

The supply of ground water has two functions. It is the major source of water in areas of agricultural and rural demand, and it is the source of base flow in all of the perennial streams in the Authority. There does not appear to be any problem with ground-water supply in the Authority. Detailed investigations are usually necessary to locate an adequate ground-water source, and these are carried out prior to any significant development in rural areas where no municipal water supply is available.

Surface water in the form of lakes, rivers and creeks is necessary to satisfy the non-withdrawal, non-consumptive and retardation or withholding demands shown in Figure 7. Since there are no instruments currently measuring surface water supply in the Authority, the supply must be estimated from a knowledge of the relationship between rainfall and runoff. There is no doubt that sufficient water is available to satisfy the immediate and near future requirements. The basic problem is too much water at the wrong time and in the wrong place.

4. Jurisdictional Control

In Canada there are many departments and agencies at the three levels of government exercising some degree of jurisdictional control over water and related land resources. The most important provincial agencies concerned with achieving the water-resource system objectives are:

a. Ontario Department of Energy and Resources Management

The Ontario Department of Energy and Resources Management administers the Conservation Authorities Act, passed in 1946 for the purpose of co-ordinating the management of the renewable natural resources on a watershed basis. The Act provides for approval of projects and for technical and financial assistance from the Government of Ontario to the Conservation Authorities to enable them to carry out their programs.

b. Ontario Water Resources Commission

The OWRC Act of 1956 established the Commission for the purpose of controlling and regulating water supply and pollution. Permits from the Commission are required for the removal of water from a stream.

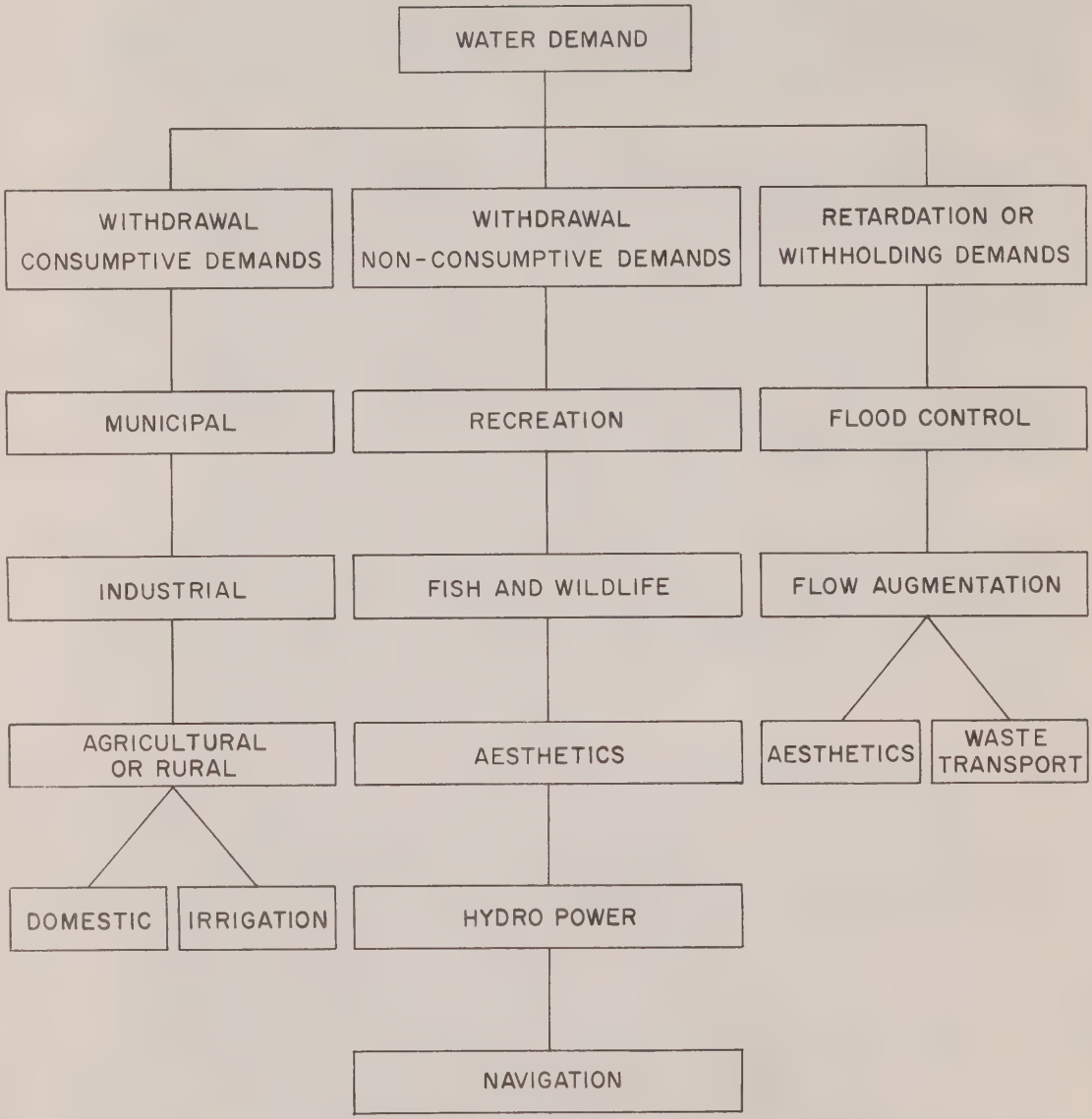

WATER DEMAND
WITHDRAWAL CONSUMPTIVE DEMANDS
WITHDRAWAL NON-CONSUMPTIVE DEMANDS
RETARDATION OR WITHHOLDING DEMANDS
MUNICIPAL
RECREATION
FLOOD CONTROL
INDUSTRIAL
FISH AND WILDLIFE
FLOW AUGMENTATION
AGRICULTURAL OR RURAL
AESTHETICS
AESTHETICS
WASTE TRANSPORT
DOMESTIC
IRRIGATION
HYDRO POWER
NAVIGATION

Fig. 7

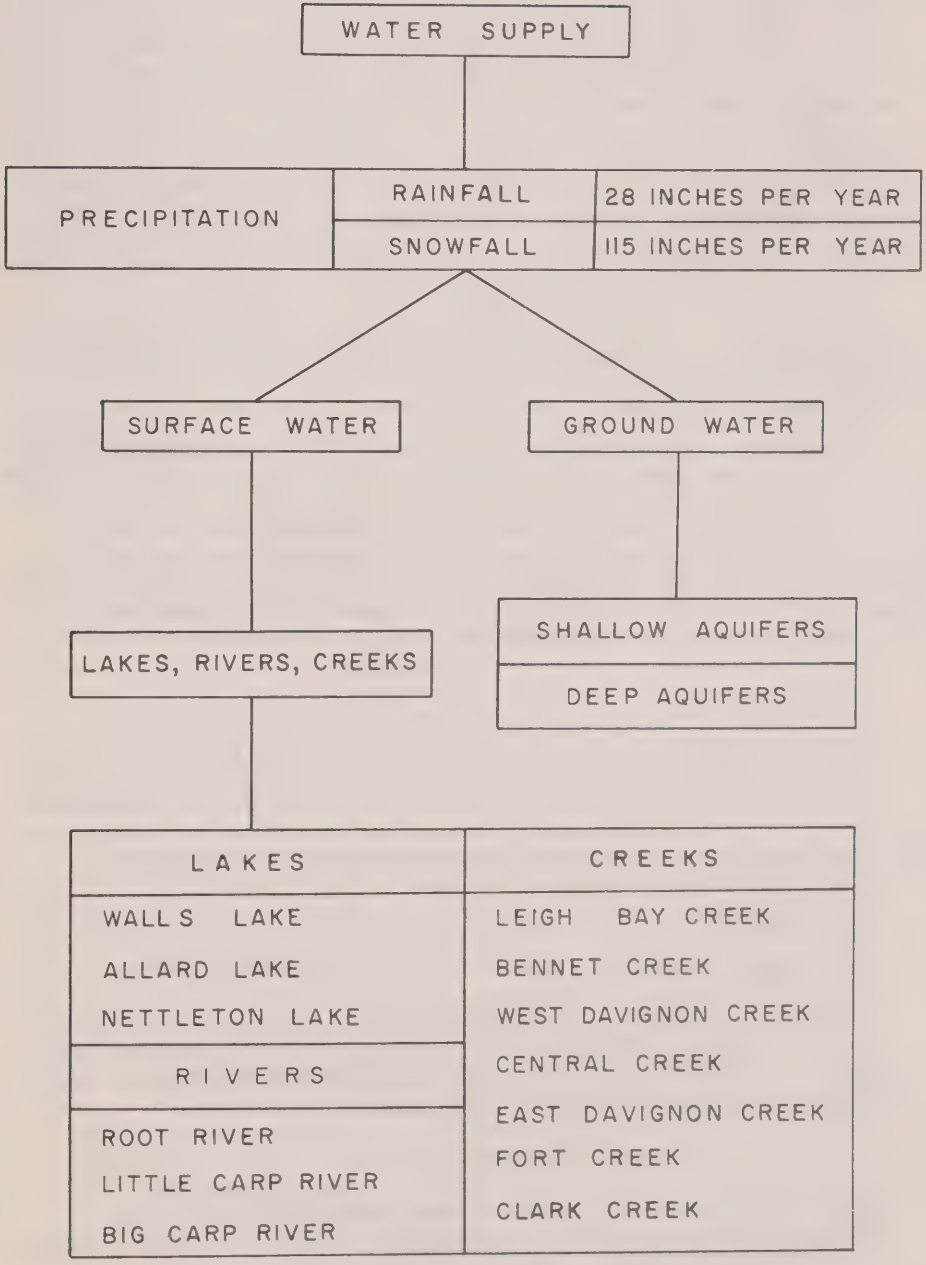

WATER SUPPLY
PRECIPITATION
RAINFALL
28 INCHES PER YEAR
SNOWFALL
115 INCHES PER YEAR
SURFACE WATER
GROUND WATER
LAKES, RIVERS, CREEKS
SHALLOW AQUIFERS
DEEP AQUIFERS
LAKES
WALLS LAKE
ALLARD LAKE
NETTLETON LAKE
RIVERS
ROOT RIVER
LITTLE CARP RIVER
BIG CARP RIVER
CREEKS
LEIGH BAY CREEK
BENNET CREEK
WEST DAVIGNON CREEK
CENTRAL CREEK
EAST DAVIGNON CREEK
FORT CREEK
CLARK CREEK

Fig. 8

The storage of water in a reservoir also is within the jurisdiction of the Commission.

c. Ontario Department of Lands and Forests

The Ontario Department of Lands and Forests administers a number of Acts concerned with resource management, and is consulted before the construction of any structure which may affect the Department's interests.

d. Ontario Department of Municipal Affairs

The Ontario Department of Municipal Affairs administers The Planning Act, an act providing for official plans and zoning by-laws to prevent the detrimental development of land.

Other organizations vitally interested in water resources management are: the provincial Department of Health; the federal Departments of Energy, Mines and Resources; Transport; and Public Works.

The Sault Ste. Marie Region Conservation Authority, consisting of members who live in the participating municipalities, is obviously in the best position to provide local management of the water and related land resources since its members are vitally interested in, and thoroughly familiar with, all of the problems in their region. Under Section 19 of the Conservation Authorities Act, 1968, the Authority has wide powers to carry out programs of watershed surveys, land acquisition, and river management for the purpose of achieving the conservation, restoration, development and management of the renewable natural resources of the area under its jurisdiction.

5. Water Problems

Some of the water problems in the Sault Ste. Marie Region Conservation Authority, arising from imbalances in the elements of demand and supply, are: Flooding, Erosion and Sediment Transport, Low Flows, and Pollution.

a. Flooding

Regular flooding has occurred in the watersheds of Fort Creek and Clark Creek and this necessitated the construction of the Fort Creek Dam and Clark Creek Channel Improvements, both begun in 1968. It is not economically feasible to attempt immediately to provide complete flood control in the system. Only those areas where the potential for property damage is greatest will be considered in detail.

The method used in the next section, "Watershed Hydraulics", computes the flood flows at key locations on each watershed for the design storm and compares these flows to the estimated channel capacities. Where the channel capacities are exceeded, there is potential flood damage.

In the city of Sault Ste. Marie the following locations were judged to be most critical: Bennet Creek, from Allen's Side Road to Goulais Avenue, between the Base Line and Second Line; West Davignon Creek

from Roosevelt to Goulais Avenue between the Base Line and Second Line; Central Creek from Korah Road to Wallace Terrace where it enters a concrete box culvert; and East Davignon Creek from Rossmore Road to a point just south of the Second Line where the creek also enters a concrete box culvert.

The Big Carp River, Little Carp River, Leigh Bay Creek and Root River watersheds are almost entirely rural and exhibit no flood problems. As development occurs in the lower reaches of these watersheds it will become imperative to provide adequate downstream channel capacities at all road crossings. A submerged culvert was observed at the intersection of the Base Line and Leigh Bay Creek. A situation in which a culvert is submerged should be avoided.

The combination of heavy rainfall and high water levels in the St. Marys River generates backwater problems at the mouths of some of the watercourses. Severe damage has occurred on the shoreline near the Big Carp and Little Carp Rivers as a result of high lake levels in combination with thunderstorms and high winds. The only solution to this problem is to ensure that all shoreline and river-side development is on high ground.

b. Erosion and Sediment Transport

Erosion may be broadly defined as "the wearing away of the earth's surface by water and wind". For purposes of this report erosion either is categorized as off-stream or on-stream. Both types are in evidence in the Authority, but only to a limited extent. The Forestry and Land Use section of this report explores the problem of off-stream erosion.

On-stream, or streambank erosion occurs at various locations, but generally the flat gradients of the upper and lower terraces decelerate streamflow velocities and, accordingly, cause a reduction in bank erosion.

There is streambank erosion at the intersection of East Davignon Creek and the Second Line where a portion of private property is gradually being lost to the watercourse, and at the intersection of Bennet Creek and Wallace Terrace where the south-west streambank is being eroded by water action. Protective measures are recommended.

The process of erosion is followed by the downstream transport of sediment to a point where deposition occurs. This deposition is a result of a reduction in stream velocity. Sediment deposits in reservoirs reduce the storage capacity over a period of time and for this reason it is suggested that upstream control of land use is necessary, particularly to prevent improper land-use practices above the Fort Creek Dam.

Fill and garbage dumps should be prohibited on any portion of a watercourse in the Authority that drains directly to the stream channel. Watershed protection should be given priority after the problem of flooding has been controlled.

c. Low Flows

The problem of low flows is one that affects only the non-withdrawal demands of the system since the withdrawal demands for water supply are insignificant on all streams in the Authority.

Higher stream flows are required for the aesthetic demands arising from the location of watercourses in urban areas, and for waste transport and dilution arising from the seepage of septic tank effluent into the watercourses in some unserviced areas. These demands are highest during dry summer periods when streamflows on some of the smaller watercourses are minimal or non-existent. The best solution to the low flow problem is the provision of storage reservoirs for flow augmentation during drought periods. However, when this is not possible a partial solution would ensure that channels are kept free of debris and have sufficient gradient to enable higher stream velocities for self-cleansing.

d. Pollution

The problem of pollution is associated with the increase in urbanization outpacing sewage collection services. The presence of numerous septic tank units in sandy soils indicates the likelihood of seepage into the watercourses. A pollution survey by the Ontario Water Resources Commission in 1966 found domestic pollution in all of the watercourses flowing through unserviced urban areas. The Authority should request regular monitoring by the OWRC of the water quality in all its streams and encourage the provision of adequate sewage services by the city to all areas in the municipality as rapidly as possible.

6. Hydraulic Considerations

This section deals with an analysis of the effects of the constraints described in Chapter II on the water resources management system of the Sault Ste. Marie Region Conservation Authority. Of particular importance is the choice of the flood flow to be used for design of hydraulic structures. The selection of the design flood will depend on the potential damage which would result in the area under consideration.

The maximum probable flood is used for design of structures only where failure might result in loss of life or disastrous property damage.

Since the projects dealing with flood control which have been recommended in this report do not involve the storage of large quantities of water, but provide adequate channel capacities to pass peak flows with the minimum possible flooding, either the 100-year flood, the regional flood, or some combination of the two is used in the design.

The greatest storm on record in Northern Ontario is the Timmins storm of 1961 which caused severe flooding in the city of Timmins and loss of life. It appears reasonable to accept this regional flood as a design storm for Sault Ste. Marie.

Streambank erosion site at crossing of East Davignon Creek and the Second Line.

Streambank erosion at crossing of Bennet Creek and Wallace Terrace.

Streamflows are also influenced by the existence of controls and structures such as dams, bridges and culverts. Two substantial dams were examined during the course of the field reconnaissance.

a. Algoma Retriever Club Dam

The Algoma Retriever Club Dam is located on Bennet Creek just south of the Sixth Line in the city of Sault Ste. Marie. The main upstream structure holds back about five feet of water at the crest and creates a 24-acre lake with an average depth of three feet. A second dam just downstream creates a small pool about three feet deep. Both dams are in a state of disrepair. The site, located on private property, is one of the few good dam sites available in the area. It is recommended that the Authority investigate the possibility of acquiring this dam for conservation purposes from the Algoma Retriever Club. The storage potential of this site is not great, but considering the size of the watercourse, failure of the existing structure during a period of peak runoff would almost certainly cause flooding in the western part of the city.

b. Crystal Creek Kinsmen Dam

The Crystal Creek Kinsmen Dam is located in the Hiawatha Park Crown Game Preserve about one-half mile downstream from Crystal Falls. Its purpose is to provide a swimming area for the Kinsmen Park, situated in the Preserve. The dam is a concrete structure with two seven-foot stop log bags. It is only six or seven years old, but is already showing signs of deterioration.

It is recommended that the Authority investigate the possibility of co-operating with the Kinsmen Club in the restoration of this dam and park and perhaps develop it as a conservation area.

In addition to these dams, there are many bridges and culverts in the Authority that do not have sufficient capacity to carry the maximum flows expected. The presence of these under-sized structures, especially in residential areas in the west end of the city, increase the flood potential of the creeks. It is suggested that the design flows given in Table 2 be used as criteria for the future construction of bridges and culverts on any of the Authority watersheds.

CHAPTER VII

ESTABLISHMENT OF WATER-RESOURCE OBJECTIVES

1. General

The establishment of objectives for the Sault Ste. Marie Region water resources management system is the third stage in the design. This involves relating programs and projects for the solution of the problems outlined in Chapter III to the broad goals and objectives of the Authority.

According to Section 18 of the Conservation Authorities Act, "the objects of an Authority are to establish and undertake, in the area over which it has jurisdiction, a program designed to further the conservation, restoration, development and management of natural resources other than gas, oil, coal and minerals."

Stated another way, the goal of a conservation authority is to carry out a program of resources management to provide solutions to the problems encountered in the area under its jurisdiction. The major water resource problems confronting the Sault Ste. Marie Region Conservation Authority, described in the previous chapter, are: flooding, erosion, sediment transport, low flows and pollution. The establishment of water resource objectives, then, will provide guidelines for the solution of these problems.

2. Goals and Objectives

A goal may be considered very general in nature, e.g., the conservation of the natural resources of the system; whereas an objective is more specifically concerned with the solution of a particular resources management problem.

The problem of flood control may be resolved by restricting the use of the flood plain and tolerating a certain degree of flooding, or by preventing the flood waters from overflowing the banks of the channel. These can be achieved in the following ways:

a. Use of Flood Plain

i. Flood Plain Zoning

In flood plain zoning the use of the flood plain is restricted by limiting its development to parks, open space or agriculture. Zoning requires municipal control of the development of the flood plain.

ii. Flood Warning System

A flood warning system requires volunteer observers to supply data on streamflow and rainfall to a central agency responsible for making flood forecasts and warning people to evacuate the flood plain if danger seems imminent.

b. Prevention of Flooding

i. Diking

Dikes are embankments constructed on each side of a river channel with the purpose of confining the flood flows to the area between the embankments.

ii. Channel Improvements

Channel improvements include widening, straightening, deepening and regrading the river channel to increase the capacity and allow higher flows to pass than were previously possible. They are usually responsible for an increase in stream velocity, and erosion control measures are sometimes necessary.

iii. Diversions

The diversion of a stream is often the only feasible solution to a flood control problem. It involves re-routing the stream to another channel or another watershed upstream of the area prone to flooding. The effect of the diversion on the other watershed must be carefully investigated to avoid creating a new problem area.

iv. Flood Storage

Flood storage involves the impoundment of flood waters in a reservoir behind a dam until they can be safely released to the watercourse at a rate not exceeding the channel capacity. Flood storage reservoirs are sometimes multi-purpose, providing recreation, flow augmentation and water supply, in addition to flood control.

It is evident from these six methods that there are many alternative solutions to the flood control problem. The critical flood-prone areas in Sault Ste. Marie are located on the flat, lower terrace where there is not a clearly defined flood plain. Extensive flood plain mapping would be required to delineate this area which, in all likelihood, would encompass much of the existing development in the west end of the city. Accordingly, the only direct means of flood control is to contain each stream within its banks. Because of the lack of reservoir sites upstream from these problem areas, and the location of residential development quite close to the existing channels, negating the possibility of the construction of dikes, the best methods of flood control appear to be channel improvements and diversions. The first major objective of the Authority should be to provide flood control in the critical downstream areas of the Bennet, West Davignon, Central and East Davignon watersheds by means of channel improvements and/or diversions.

The problem of erosion and sediment transport is associated with watershed protection. The solution of bank erosion problems generally involves the provision of some form of stabilization. A second objective of the Authority should be to encourage and promote, by example, good land management practices in all of the land area under its jurisdiction.

The problem of low flows could only be solved by storing water upstream during periods of high runoff to release during the summer months for flow augmentation. Owing to the lack of reservoir sites this is not possible.

Another problem associated with low flows is the accumulation of debris in stream channels, impairing both the natural beauty of the watercourse and the ability of the channel to facilitate subsequent higher flows. A third objective of the Authority should be to preserve the existing [illegible] channels by prohibiting the dumping of debris and by carrying out a maintenance program for debris removal.

The problem of pollution control is more directly the responsibility of the Ontario Water Resources Commission. However, the Authority should encourage the education of the citizens about the consequence of pollution, and notify the OWRC of any obvious sources of pollution. The fourth objective of the Authority is to prevent pollution within its boundaries to the extent that it makes citizens aware of existing and potential sources of pollution and requests action from the OWRC when necessary.

In summary, the definition of the water resources management system and the description of the elements or components of the system has led the way to the establishment of water-resource objectives, shown in Figure 9.

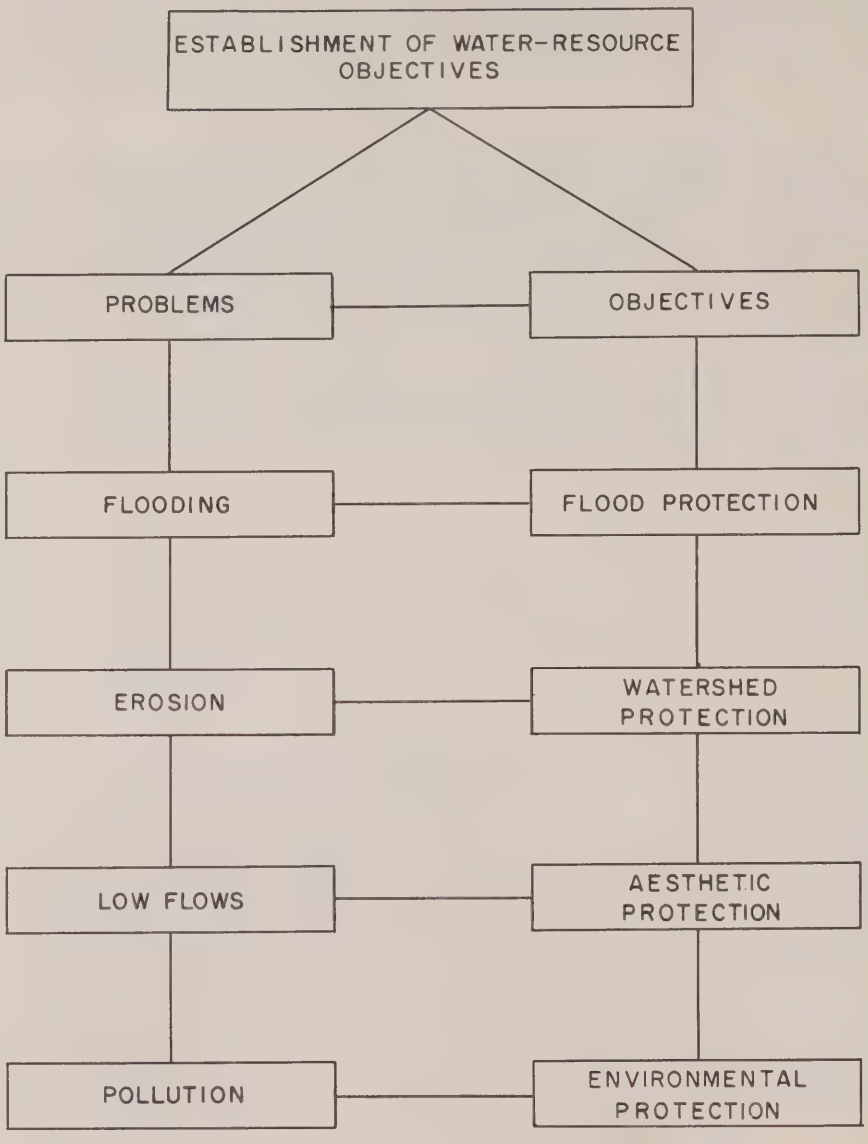

ESTABLISHMENT OF WATER-RESOURCE OBJECTIVES
PROBLEMS
OBJECTIVES
FLOODING
FLOOD PROTECTION
EROSION
WATERSHED PROTECTION
LOW FLOWS
AESTHETIC PROTECTION
POLLUTION
ENVIRONMENTAL PROTECTION

Fig. 9

CHAPTER VIII

ACHIEVEMENT OF WATER-RESOURCE OBJECTIVES

1. General

The final stage in the system design deals with the achievement of the water-resource objectives of the Sault Ste. Marie Region Conservation Authority. This involves a careful consideration of the alternative solutions to the water problems followed by selection of the remedial measures that will best resolve these problems and attain the system objectives.

Every problem has at least two solutions. One is "do nothing". Almost every problem has numerous solutions of which one is generally considered "most feasible". From an engineering point of view, feasibility implies the most practical economic solution, based on an analysis of the benefits and costs of each alternative. The solution of many water management problems such as flooding, erosion and pollution, and the applicability of benefit-cost studies, is complicated by the difficulty of placing a dollar value on such things as threat to human life, potential flood damage, erosion damage and pollution.

The following proposals are reasonably justified on financial grounds and merit careful consideration by the Authority. Phasing of the projects over a period of years is recommended to avoid high initial outlays and to spread the cost more equitably among those who will benefit from the projects in the future.

2. Flood Control Measures

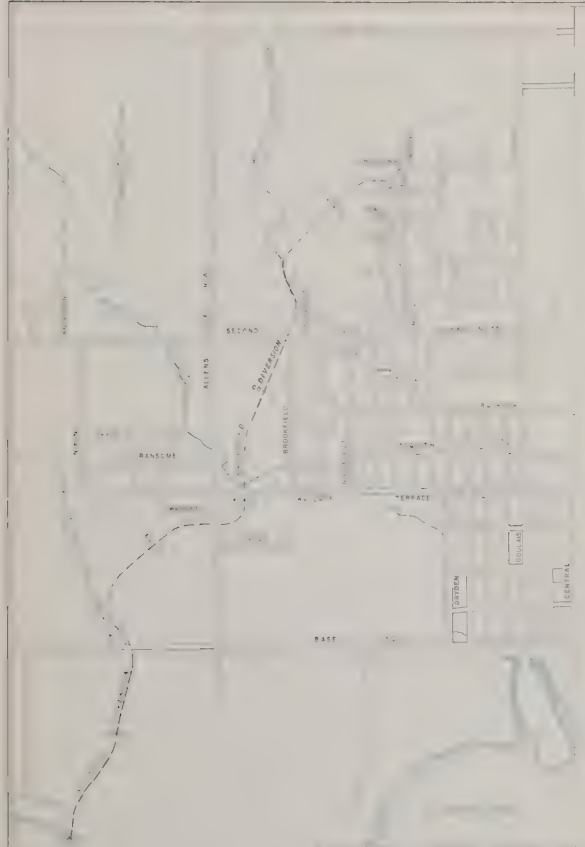
Since human occupancy of the land subject to flooding, in the western part of the city, is sufficiently dense to make relocation expensive and impractical, flood control, through channel improvements or diversions is necessary. The following are suggested remedial measures for the control of flooding on the five creeks immediately west of the Fort Creek watershed.

a. East Davignon Creek

The recommendations, made by consulting engineers in their "Report on Central, East Davignon and Clark Creeks" in 1966, have been reviewed and are essentially sound. From the downstream crossing of East Davignon Creek and the Algoma Central Railway line to Wallace Terrace, channel improvements and additional aqueduct capacity, including land, were proposed at a total cost of $284,750.

b. Central Creek

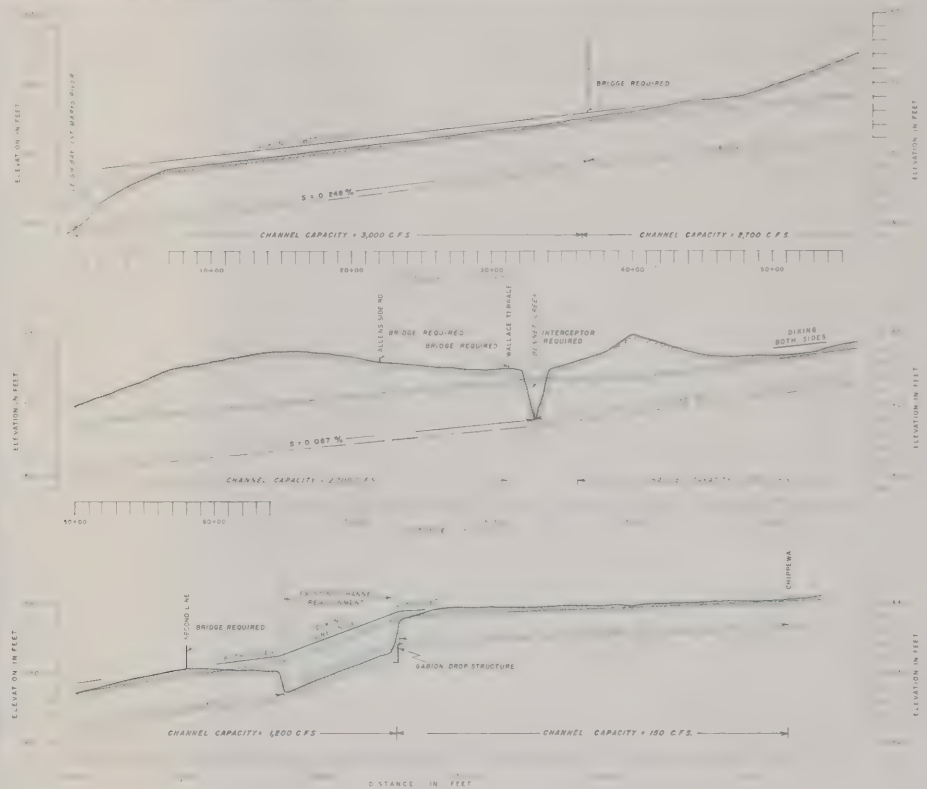
Again, the recommendations of consulting engineers in their 1966 report to the Authority, regarding channel improvements to Central Creek from Korah Road to the aqueduct at Wallace Terrace are essentially sound at a cost of $303,750. This cost does not include the provision of relief capacity to the underground aqueduct, which is presently undersized. In 1965, consulting engineers prepared a "Drainage Report" for the city of Sault Ste. Marie and they recommended the construction of a



LOCATION PLAN

SCALE – FEET

0 500 1000



PROFILE

LEGEND

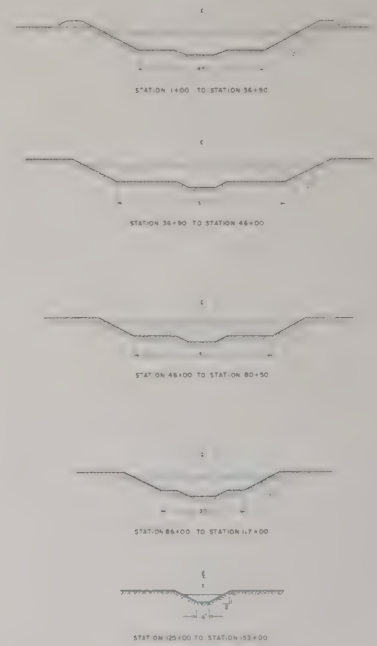
EXISTING GROUND SURFACE

MAXIMUM WATER LEVEL

DIKING REQUIRED

BOTTOM OF CHANNEL

TYPICAL SECTIONS



PROPOSED
WEST DAVIGNON – BENNET DIVERSION

NOTES.

LOW FLOW CHANNEL – BOTTOM WIDTH 10', DEPTH 2, WITH 2:1 SIDE SLOPES

ST. MARYS RIVER AT LEIGH BAY TO BE DREDGED TO ACCOMODATE DIVERSION

PUBLIC UTILITIES DISTURBED BY DIVERSION NOT SHOWN

DIMENSIONS, ELEVATIONS AND LOCATIONS SHOWN ARE APPROXIMATE ONLY

Fig. 10

CONSERVATION AUTHORITIES BRANCH, Dept. E.B.R.M. — M.E.M. — 1960

relief storm sewer of 78-inch equivalent diameter from Central Creek to West Davignon Creek, just south of Wallace Terrace, at a cost of $136,000. This partial diversion of Central Creek is possible only if the proposed diversion in "c." is carried out, thus freeing the channel from carrying the flow of West Davignon Creek at this point. The total cost, at 1966 prices, for flood control measures on Central Creek is $439,750.

c. Combined Diversion of West Davignon and Bennet Creeks

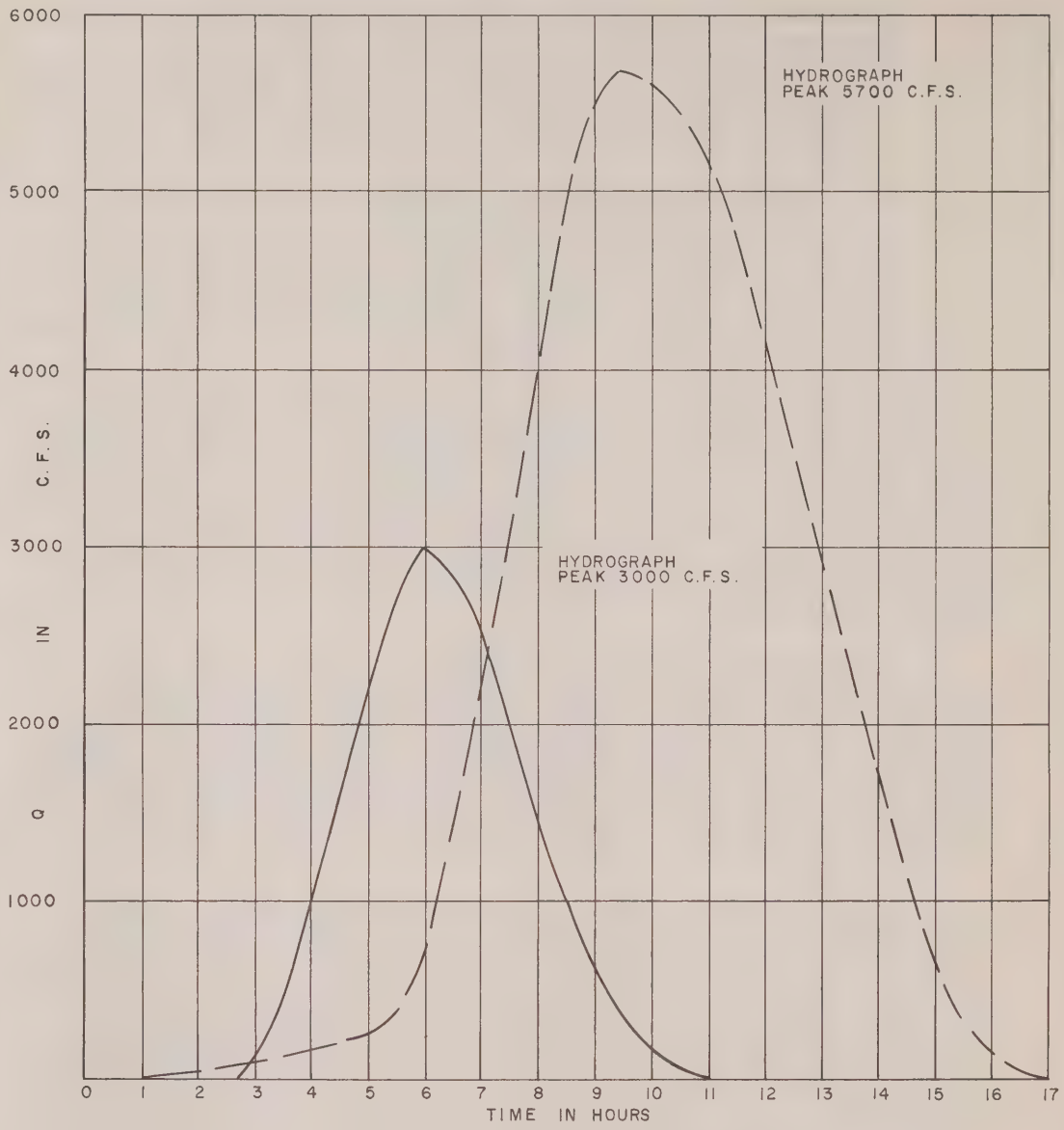
The only practical solution to the flooding problems encountered in the city, west of Goulais Avenue, between the Base Line and the Third Line, is the diversion in stages of West Davignon Creek into Bennet Creek north of Wallace Terrace, and Bennet Creek into Leigh Bay Creek at the Base Line, shown in Figure 10.

During the period 1960 to 1968, four specific reports were prepared for the city suggesting various alternatives for diversions of the creeks in the west end. The first report in October, 1960, recommended general channel improvements to East and West Davignon Creeks in the Bayview Area, south of Wallace Terrace and future re-alignment of West Davignon Creek from the Second Line to Wallace Terrace where it would join Bennet Creek upstream from the present junction point. A second re-alignment of the combined Bennet-West Davignon Creek between Bonney Street and Lake Superior, west of the existing channel, was also recommended.

A supplement to this report was prepared in February, 1961, and it recommended the westward diversion of East Davignon Creek to the West Davignon diversion, just north of the Base Line, in order that all four creeks in the Bayview Area would discharge to the St. Marys River, west of the existing West Davignon Creek channel. This proposal was recommended by the consulting engineers as a start towards flood control and as beneficial to Algoma Steel since it would eliminate the problem of silt load carried into Algoma's ship slip by Central and East Davignon creeks.

In March of 1966, a third report was prepared for the city of Sault Ste. Marie and the Algoma Steel Corporation, on the diversion of West Davignon Creek into Bennet Creek and Bennet Creek into Leigh Bay Creek. This proposal, essentially, is similar to the diversion shown in Figure 10. Some changes have been made in alignment and in the calculation of the design flood flows. The Timmins Storm Hydrograph and 100-year Storm Hydrograph, shown in Figure 11, represent two conditions that could occur in the new Leigh Bay Creek channel, south of the Base Line. The 100-year Storm Hydrograph peak of 3,000 c.f.s., for the largest channel section of the diversion, south of the Base Line, is adequate due to the fact that the potential for severe property damage will not be as great in the area where the diverted streams will flow, provided that future developers recognize the fact that the new channel is capable of overflowing its banks under conditions approaching those of the Timmins storm.

The final diversion report in July 1968, recommended the use of a design flow figure of 5,200 c.f.s., using the Timmins storm data and stated that this is the criterion used by the Department of Energy and Resources Management for projects subsidized by the province. However, for the reason previously mentioned, it is felt that the proposal as outlined in the March 1966 report, is adequate for this project.



FLOOD HYDROGRAPHS

FOR

REGIONAL STORM & DESIGN STORM

FOR

PROPOSED

WEST DAVIGNON – BENNET DIVERSION

LEGEND

REGIONAL STORM HYDROGRAPH (12 HOUR STORM) — —

DESIGN STORM HYDROGRAPH (6 HOUR STORM) ———

CONSERVATION AUTHORITIES BRANCH – Dept. E. & R.M. – P.D.T. 1968

Fig. 11

3. Cost Estimates of Flood Control Measures

a. East Davignon Creek (1968 prices)

Channel Improvements (including land, structures and additional aqueduct capacity)	$345,000

b. Central Creek (1968 prices)

Channel Improvements (including land and structures)	368,000
Trunk Relief Sewer (to West Davignon Creek) ...	165,000
Sub-Total	$533,000

c. Combined Diversion of West Davignon and Bennet Creeks (1968 prices)

Item No.	Item	Cost
1	Earth Excavation	$253,000
2	Earth Diking	8,000
3(a)	Structure at Base Line Road	90,000
(b)	Structure at Allan's Side Road	70,000
(c)	Structure at Wallace Terrace including Bennet Creek Interceptor	120,000
(d)	Structure at Highway 550	40,000
(e)	Arden Road Ditch Drop Structure ...	10,000
4	Seeding and/or Sodding	16,000
5	Dredging	10,000
6	Utilities	80,000
7	Dewatering	20,000
8	Fencing	10,000
	Sub-Total	$727,000
	Engineering & Contingencies @ 25%	182,000
	TOTAL Construction Cost	$909,000
	LAND, 51 Acres	77,000
	TOTAL	$986,000

4. Other Measures

a. Watershed Protection

The Authority should encourage and promote good land-use practices throughout each watershed, especially with regard to bank erosion and the dumping of fill of any kind in and around watercourses. Erosion control measures are costly and should only be considered where a definite benefit can be obtained. The most serious bank erosion problem encountered during the field reconnaissance, at the crossing of East Davignon Creek and the Second Line, requires stabilization by means of gabions (rock-filled wire baskets), to prevent the undercutting of the bank

and subsequent loss of more land. This would cost approximately $1,800. Since bank erosion is not a major problem it is recommended that the Authority take steps to document all points of erosion as soon as they come to its attention during the years when the more urgent problems of flooding are being resolved. It will then be in a position to better assess the necessity of stabilization measures at various locations.

Under Section 26 (1) (f), of the Conservation Authorities Act, 1968, the Authority has the power to "prohibit or regulate the placing or dumping of fill of any kind in any defined part of the area over which the Authority has jurisdiction". The Authority should pass flood plain regulations immediately and designate the area upstream from the Fort Creek Dam as an area where dumping is prohibited to ensure that sedimentation and pollution will not occur in the Fort Creek Reservoir.

b. Aesthetic Protection

The numerous small streams in the Authority, especially those flowing through developed areas, should be maintained in a manner that improves the carrying capacity of the channels in order that the lower flows during dry periods can be facilitated at higher velocities. This is important from an aesthetic standpoint since a sluggish stream is not pleasant to look at, and from an environmental and flood control standpoint since flooding and health problems are associated with debris-blocked channels. Accordingly, the Authority should inspect the streams under its jurisdiction at regular intervals and solicit the aid of the city works department in setting up a maintenance program.

c. Pollution Control

Within the general concept of conservation, the Authority has an obligation to document and report, to the Ontario Water Resources Commission, existing or potential sources of pollution in any of its watercourses. In addition, the Authority should request the OWRC to carry out regular pollution surveys on all the streams to ensure that changes in water quality over a period of time can be determined.

APPENDIX

List of Previous Reports

1. Report on Soil Investigations for Proposed Clark Creek Channel Improvements — Dominion Soil Investigation Limited, April 1968.
2. Bennet Creek Diversion Detailed Investigation — Proctor and Redfern, July 1968.
3. Report on Fort Creek Aqueduct Appraisal for the Sault Ste. Marie Region Conservation Authority — Proctor and Redfern, October 1967.
4. Investigation of the Bennet Creek Diversion — Proctor and Redfern, March 1966.
5. Stability Analyses of Fort Creek Dam — Dominion Soil Investigations Limited, July 1966.
6. Report on the Hydrology of the Fort Creek Watershed and Proposed Flood Control Works — H. D. Ayers, P.Eng., July 1966.
7. Report on Central, East Davignon and Clark Creeks for the Sault Ste. Marie Region Conservation Authority — Proctor and Redfern, August 1966.
8. Water Quality in Streams Tributary to Saint Marys River — Sault Ste. Marie — Ontario Water Resources Commission, October 1966.
9. City of Sault Ste. Marie, Drainage Report, Volumes 1 and 2 — Proctor and Redfern, December 1965.
10. Report on Flooding of August 12, 1965 — A. A. Jackson, P.Eng., Deputy City Engineer, City of Sault Ste. Marie.
11. Report on the Construction of a Dam at Fort Creek — Proctor and Redfern, April 1963.
12. Bayview Drainage Supplementary Report — Proctor and Redfern, February 1961.
13. Drainage of the Bayview Area — Proctor and Redfern, October 1960.
14. Report on Flood Control of Fort Creek for the City of Sault Ste. Marie — Proctor and Redfern, May 1960.

BIBLIOGRAPHY

1. The Climate of Northern Ontario — Meteorological Branch, Department of Transport — L. J. Chapman, 1953.

2. Design of Water Resource Systems — Harvard University Press — Maass, Hufschmidt, Dorfman, Thomas, Marglin, Fair — 1962.

3. Geology of the Sault Ste. Marie Area — District of Algoma 35th Annual Report, Ontario Dept. of Mines — R. G. McConnell, 1926.

4. Handbook of Applied Hydrology, Section 26, Edited by V. T. Chow, 1964.

5. Strategy for Michigan Water Resources Management — A Systems Approach, Technology Planning Consultants, 1966.

6. Water Resources Development — Butterworths, 1965, E. Kuiper.

7. Timmins Flood, August 31 - September 1, 1961 — A Design Storm for Ontario; Meteorological Branch, Dept. of Transport.

8. Temperature and Precipitation Tables for Ontario, Volume IV, Meteorological Branch, Department of Transport, 1967.